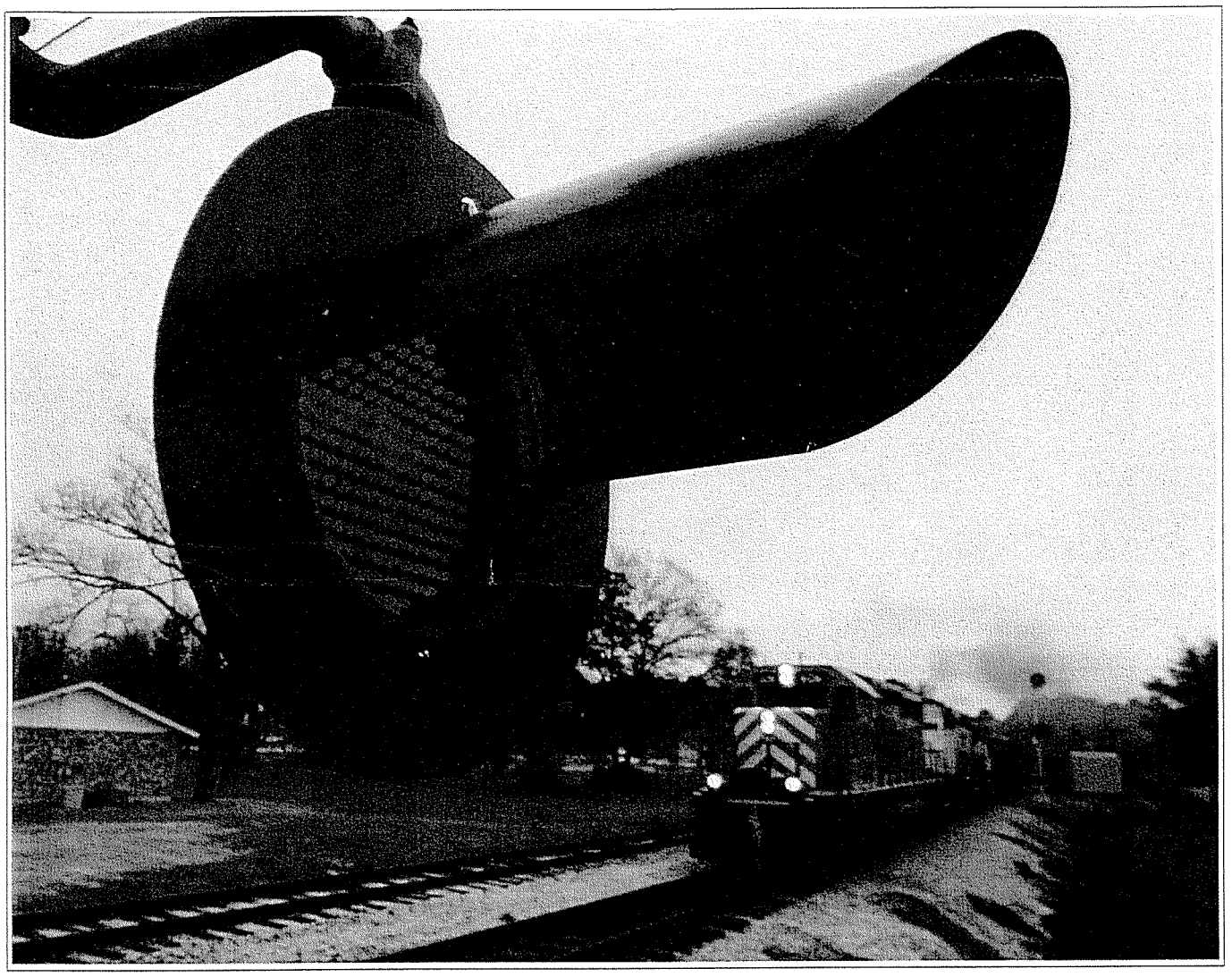
HIGHWAY CROSSING
WARNING SYSTEMS

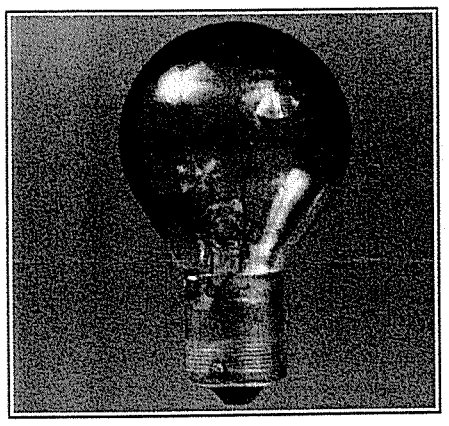
SASIB RAILWAY
GRS



AURORA™ Highway-Crossing Signal and Gate-Arm Light

AUG - - 1997

THE LAST SIGNALS YOU MAY EVER NEED



For years, you've had to rely on fragile, incandescent bulbs for highway-crossing signals. You've replaced them countless times as a result of normal wear, damage from vibration, or acts of vandalism. Bulbs are unreliable and have short life-spans. They fail when you least expect it.

Introducing AURORA™ Signals – all-new highway-crossing and gate-arm signals that are engineered to save you money.

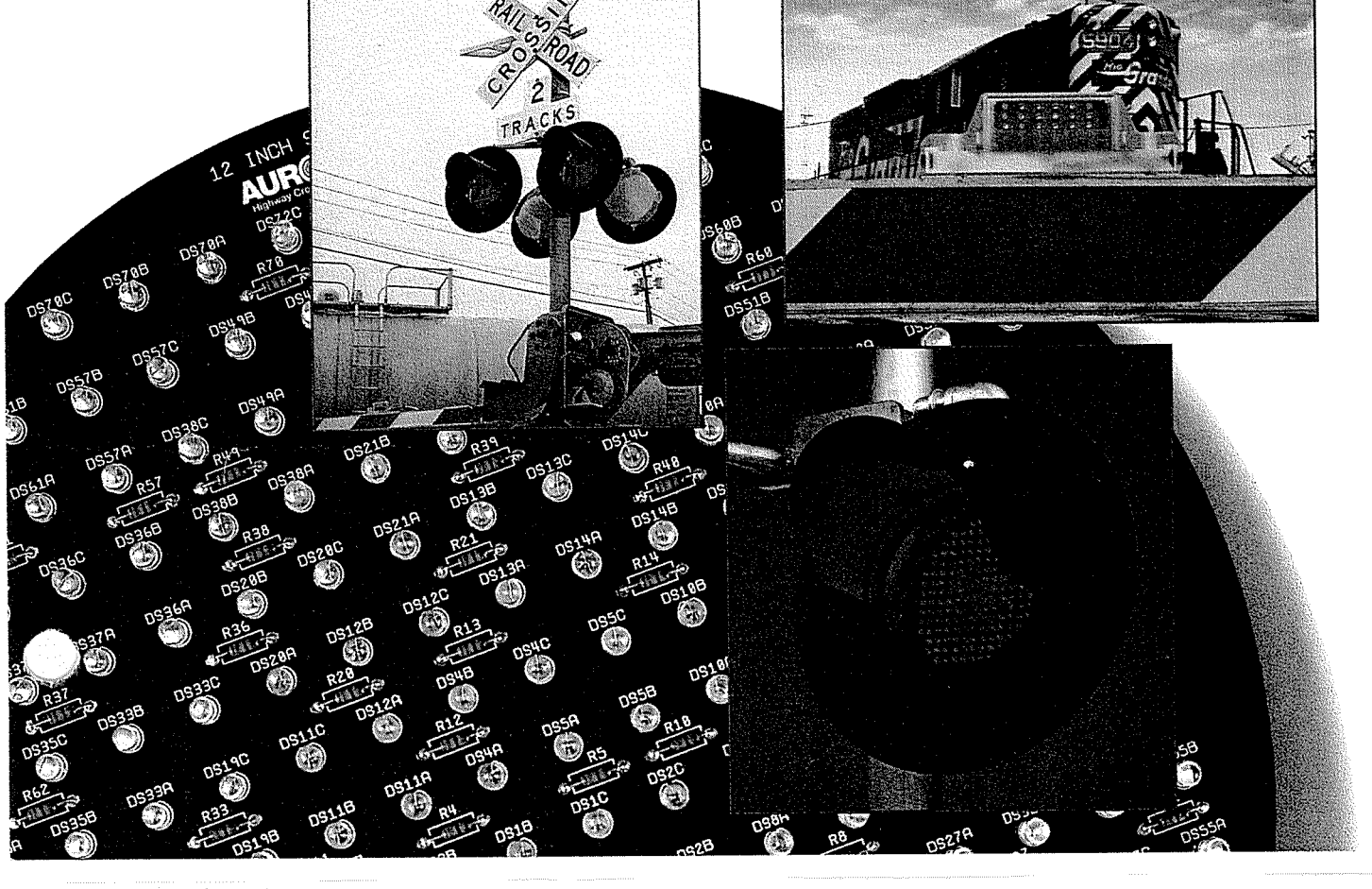
AURORA signals use rugged light emitting diode (LED) technology instead of a single, fragile, filament bulb. The LED array of the AURORA signal emits high-intensity light using a fraction of the power required by an incandescent bulb. With AURORA signals, there is less stress on lighting circuitry and solid-state flasher relay contacts. And, AURORA signals don't catastrophically "burn out", so expensive emergency service calls to replace a burned-out bulb are eliminated. In fact, the LEDs used in the AURORA signal have a life expectancy of up to 100,000 hours – twenty times greater than conventional incandescent bulb systems. They have an extraordinary mean time between failure (MTBF) rating of over 25-years.

COMPLIANCE WITH FRA 234.221 REGULATIONS

The AURORA signal helps solve compliance issues with voltage requirements for highway-crossing warning systems as specified by FRA §234.221.

The current draw of an AURORA signal is less than half of an incandescent 25-watt bulb. The signal greatly reduces the demand on the battery backup system.

AURORA signals virtually eliminate phantom signals. There is no reflector dish and phankills are not required. Sunlight transmitted into the signal cannot be reflected back as with incandescent signals.

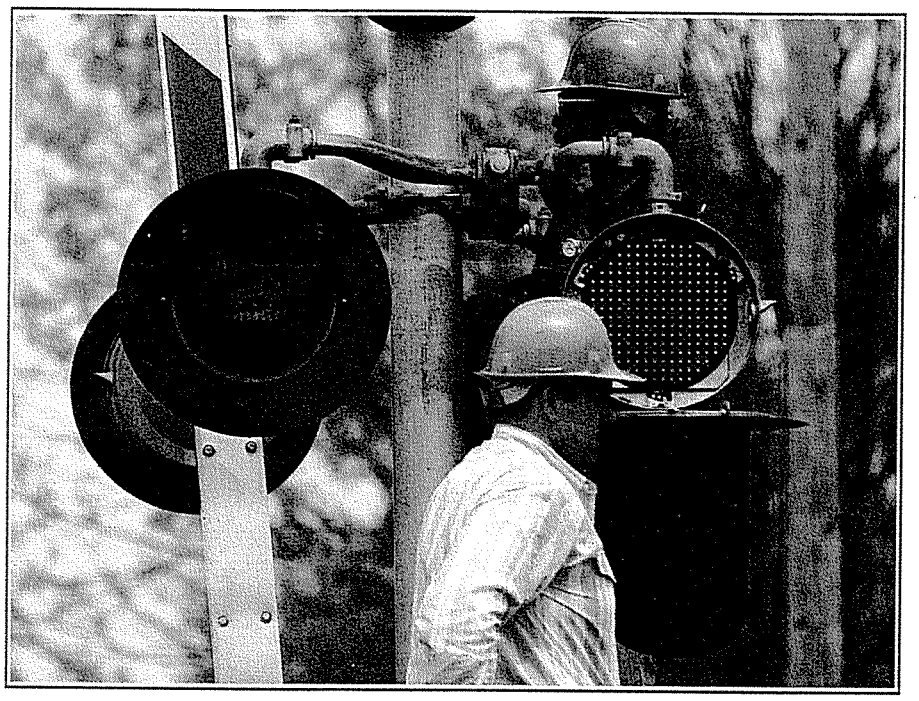


REDUCED MAINTENANCE REQUIREMENTS AND COSTS

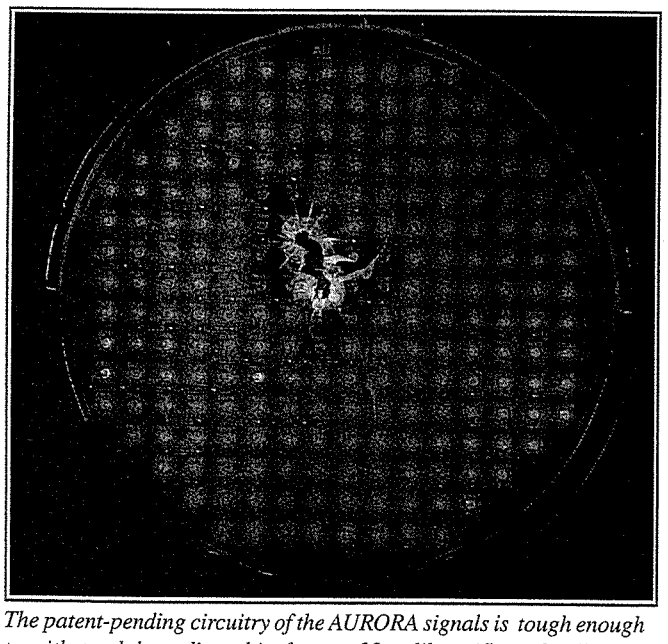
CHANGE FROM EXISTING INCANDESCENT SYSTEMS FAST

The AURORA™ signal is compatible with most AC- and DC-based control systems for fast, economical installation. Change to more dependable and cost-effective AURORA signals in minutes. Simple tools are all you need– slotted screwdriver, Phillips screwdriver and AAR terminal wrench. The AURORA signal emits a 30° cone of light without the use of a lens, so signal alignment is fast and easy. The time-consuming and precision adjustments required for reflectorized dishes and lenses are eliminated. Detailed focusing is not required. Set it. Forget it.

AURORA signals are ideal for front-light, back-light or cantilever applications. Unlike bulb-based systems having up to three different roundel configurations, the AURORA signal has a universal configuration – one kit fits all. That means fewer parts to inventory and fewer parts for maintenance crews.



Replacing an existing bulb system with a new AURORA signal requires less than 15-minutes. AURORA Retrofit Kits for 8- and 12-inch signal heads include everything you need for fast installation.



The patent-pending circuitry of the AURORA signals is tough enough to withstand three direct hits from a .22-caliber rifle and still operate.

VANDAL RESISTANT

AURORA signals are simple to install and even simpler to maintain. Their rugged design withstands common acts of vandalism since there is no fragile filament, reflectorized dish or fresnel lens.

IMPROVED LIGHTING CHARACTERISTICS

AURORA signals have a faster, more noticeable on/off flash unlike the fade-in/fade-out of an incandescent bulb. Combined with the 30° cone of light, AURORA signals supply a more consistent, more noticeable and more visible highway-crossing signal, even during inclement weather conditions. They have the ability to "cut through" conflicting light sources due to its excellent chromaticity. The AURORA signal meets or exceeds chromaticity requirements for red as specified by:

- ❑ AAR 7.1.10
- ❑ CIE PUB 2.2-1975
- ❑ ITE VCSH 8.04

The AURORA signal also complies with the Manual on Uniform Traffic-Control Devices (MUTCD).

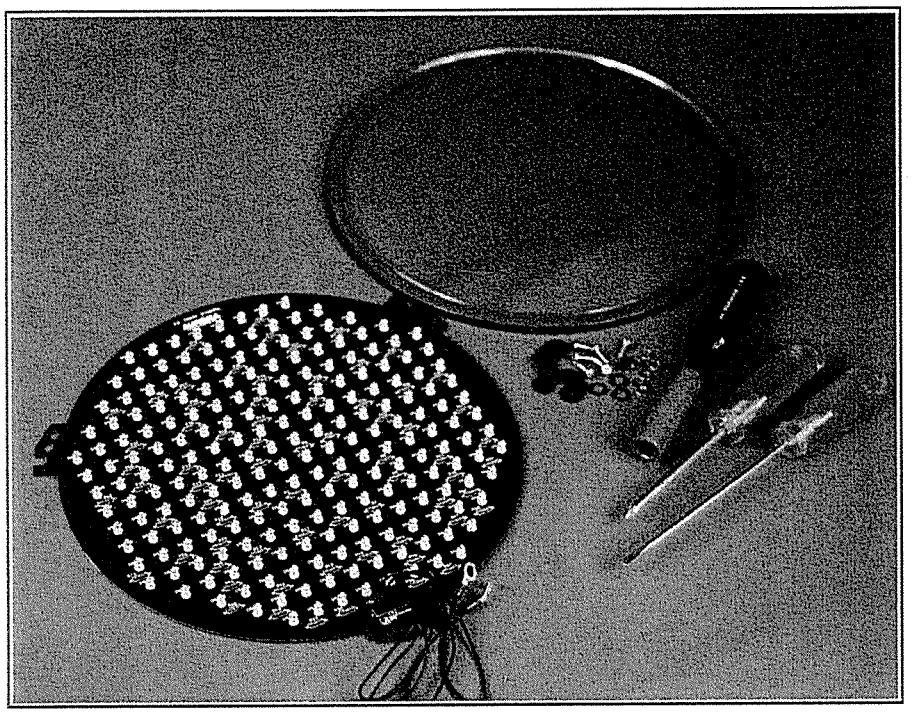
SPECIFICATIONS AND ORDERING INFORMATION

PLUG-COMPATIBLE WITH LEADING SIGNAL HEADS

The AURORA Highway-Crossing Signal is "plug-compatible" with signal heads of leading suppliers including:

- ❑ Western-Cullen Hayes
- ❑ Premier Products
- ❑ Modern Industries (Harmon)
- ❑ Union Switch & Signal
- ❑ Safetran Systems

And with the AURORA Retrofit Kits, you don't need special adapters, additional hardware or special tools. One kits fits them all.



The AURORA Retrofit Kit. (Tools not included.)

SPECIFICATIONS

AURORA™ Highway-Crossing Signal

Nominal Current
1.2A @ 10Vdc
1.3A @ 10Vac

Power Rating
12W @ 10Vdc
13W @ 10Vac

AURORA™ Gate-Arm Lights

Nominal Current
0.45A @ 10Vdc
0.5A @ 10Vac

Power Rating
4.5W @ 10Vdc
5W @ 10Vac

Specifications for both the AURORA™ Signal & Gate-Arm Lights

Input Voltage
8.5 to 12Vdc
8.5 to 12Vac

Temperature Range
Operating -40°C to +70°C
Storage -40°C to +85°C

Complete test-specifications are available upon request. Contact your SASIB Railway GRS Sales Representative.

ORDERING INFORMATION

The AURORA Signal Head (COMPLETE) includes a clear, polycarbonate lens, LED light-source board, background, hood and mounting hardware. AURORA Retrofit Kits include a clear, polycarbonate lens, LED light-source board, plus mounting hardware. Gate-Arm Kits include three housings with LED boards installed, three base-plates, and mounting hardware.

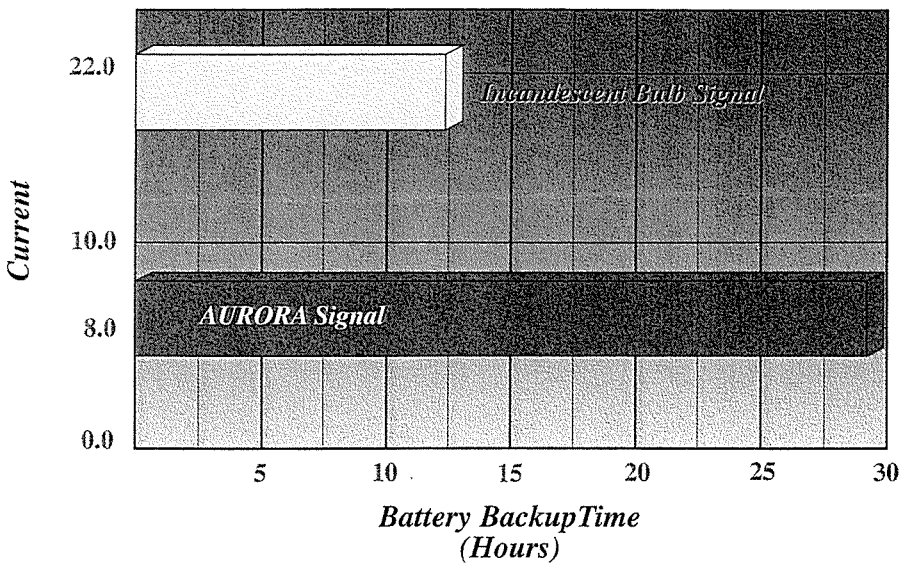
Catalog Number	Drawing Number	Description
A30-945	73001-141-01	12-inch AURORA Signal Head (COMPLETE)
A30-946	73001-142-01	8-inch AURORA Signal Head (COMPLETE)
A30-941	59649-200-01	12-inch AURORA Signal Retrofit Kit (one per kit)
A30-942	59649-202-01	8-inch AURORA Signal Retrofit Kit (one per kit)
A30-944	59649-201-01	AURORA Gate-Arm Light Kits (set of three lights per kit)

LESS ENERGY CONSUMPTION AND LONGER BATTERY LIFE

Installations using 25-watt bulbs, configured with eight highway-crossing signals and six gate-arm lights (two gate mechanisms with three lights per gate), have a typical current draw of 22-amperes. This is a significant current draw, especially if the system is required to work off the backup battery plant.

An identical system setup, using AURORA™ signals, has a power consumption of only 8-amperes. This savings in current means you can avoid costly equipment and cabling upgrades – especially for larger highway-crossing systems with multiple signals and cantilevers. With an AURORA system, you can eliminate repeater cases at cantilever installations and use smaller gauge wire.

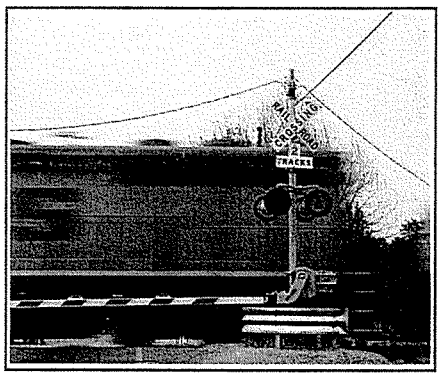
Your AURORA system will operate longer on battery backup power. Or, you can use lower capacity, lower cost batteries to achieve the same battery backup capability.

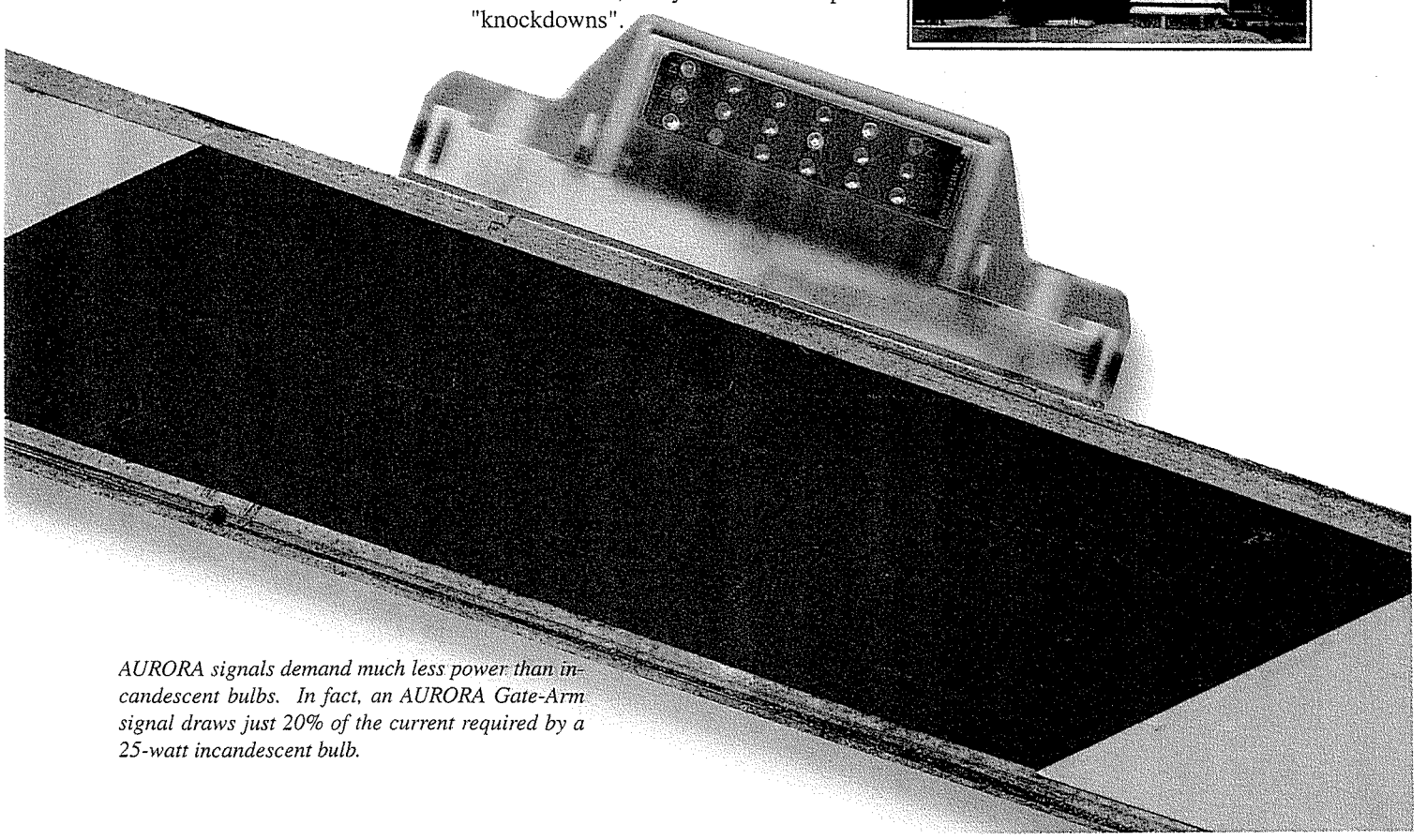


80% POWER REDUCTION WITH AURORA GATE-ARM LIGHTS

AURORA™ Gate-Arm lights are easy to install and use less than 20% of the power required by conventional incandescent gate-arm lights.

Plus, AURORA Gate-Arm lights are rugged. Housed in an impact-resistant, molded case, they will hold up to "knockdowns".





AURORA signals demand much less power than incandescent bulbs. In fact, an AURORA Gate-Arm signal draws just 20% of the current required by a 25-watt incandescent bulb.

COMPARISON SUMMARY

CHARACTERISTIC	AURORA™ SIGNALS	INCANDESCENT SIGNALS
Light Source	❑ Rugged LED Array	❑ Fragile Tungsten Filament
Optical Lens/Filtering	❑ Protective Lens Only	❑ Both
Viewing configurations	❑ Single, Easy to Install & Align	❑ Multiple, Difficult to Focus
Life Expectancy	❑ 75,000 - 100,000 Hours	❑ 3,000 - 5,000 Hrs.
Failure Mode	❑ Graceful Degradation	❑ Catastrophic
Phantom Signals	❑ None, No Reflector Dish/Phankill	❑ Very Susceptible
Vandal Resistance	❑ Excellent	❑ Very Susceptible
Resists Shock/Vibration	❑ Excellent, Solid-State Device	❑ Poor, Filament Bulb
Input Voltage	❑ AC or DC	❑ AC or DC
Current @ 10Vdc	❑ 1.2A	❑ 2.5A
Power Consumption	❑ 12-Watts	❑ 25-Watts
Installation Time	❑ Less than 15-minutes	❑ Typically 30-minutes or longer
Focusing	❑ None required	❑ Bulb to Reflector Dish
Alignment	❑ Precise light, Simple	❑ "Hot Spot", Difficult

SASIB RAILWAY

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SCITEL TELEMATICS Ltd. – *Hungary*
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CASCO SIGNAL Ltd. – *China*
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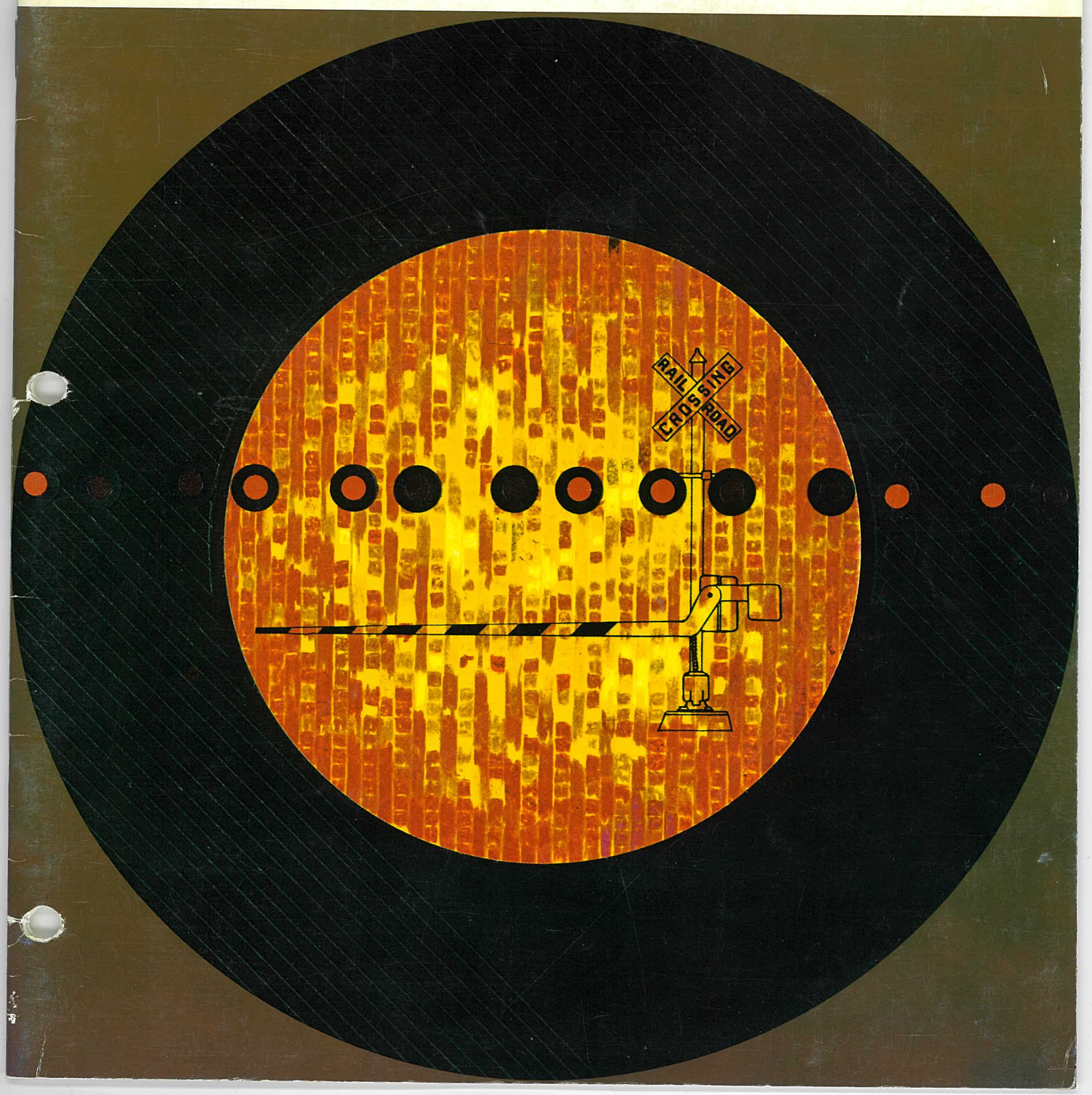
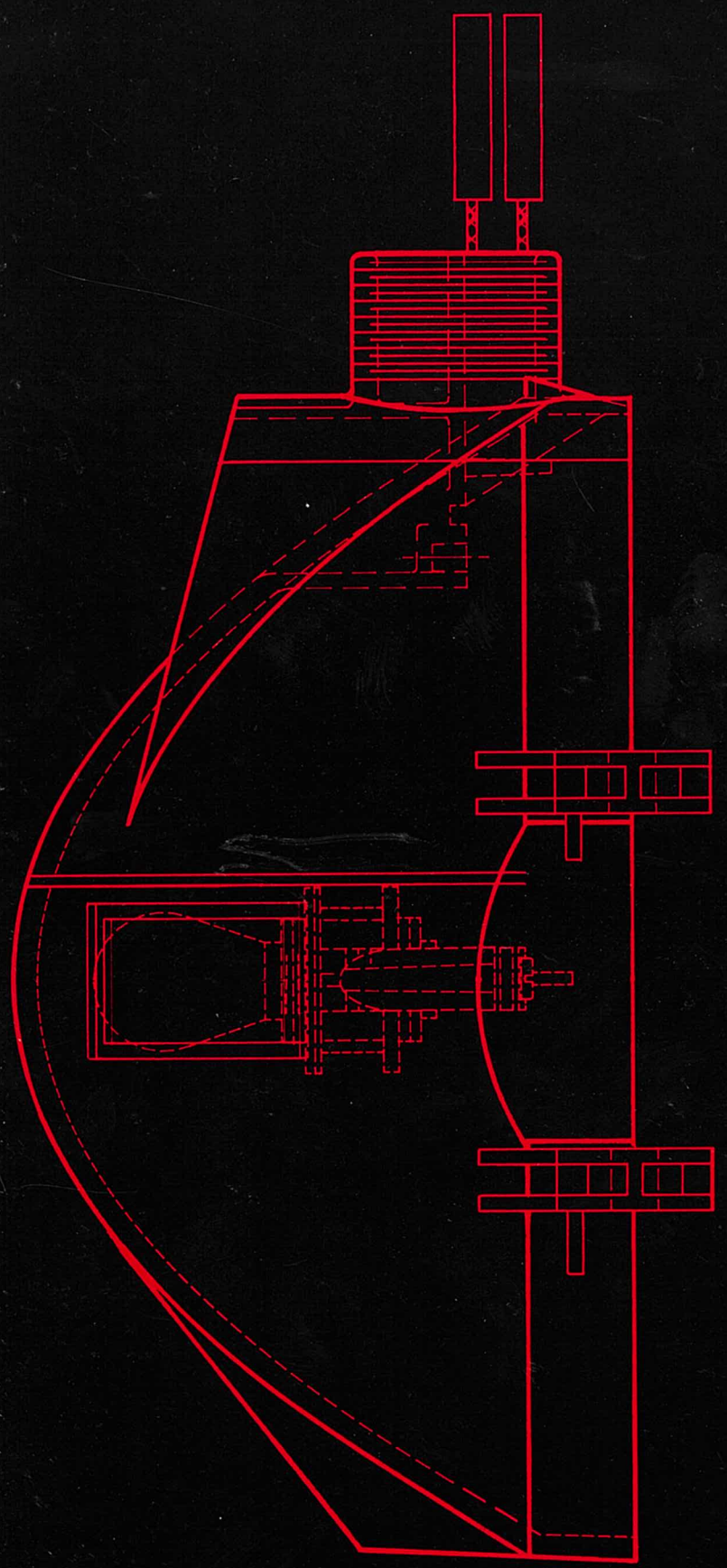
GRS CATALOG **30-1**

HIGHWAY CROSSING WARNING SYSTEMS

GRS





CONTENTS

INTRODUCTION 3
SIGNAL ASSEMBLIES 3
- Flashing Light Units 4
- Type D Crossing Gate Mechanism 4

CASE WIRED EQUIPMENT 5
- Equipment Cases 5
- Plug-In Relays 5
- Test Box 5
- Rectifiers 6
- Transformers 6
- Flasher Module 6
- Approach FSO 7
- Island FSO 8
- Coded FSO 8

PRINCIPLES OF TRAIN DETECTION AND CONTROL CIRCUITRY 9
- Lamp Lighting 10
- Directional Control 10
- Power 10

TYPICAL ARRANGEMENTS 11
- A-c Rectified (Type "C") 11
- A-c Rectified with D-c Island 11
- Direct Current 11
- Frequency Shift Overlay 11

ORDERING INFORMATION 12
- Signal Assemblies 13
- Accessories 14
- Test Boxes 20
- Design Questionnaires 23, 25

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INTRODUCTION

GRS highway crossing equipment provides complete warning on an around-the-clock basis. The powerful LEX-C® flashing signal units have high efficiency optics, superior to those of any conventional highway crossing signal, and they are lightweight, virtually maintenance-free and vandal resistant. The flashers, coupled with reflective sheeting signs, time-proven control equipment and the GRS Type D gate mechanism, provide the ultimate in grade crossing warning systems.

SIGNAL ASSEMBLIES

A typical highway crossing signal, Figure 1, is equipped with four LEX-C flashing light units. Two signals like this are used for single-track crossings. For multiple-track crossings, a track sign may be added to indicate to the motorist that he is about to cross more than one track and that he should be alert to anticipate the possibility of more than one train approaching or occupying the crossing. Two sets of flashing lights, set back-to-back on each signal, not only present a more arresting warning, but also furnish an important warning in situations where a train approaching on the farther track from the motorist may be obscured by another train just clearing the crossing on the nearer track.

Figure 1. Typical highway crossing signal.

For special applications, the signals may be equipped with only two flashing light units, or where streets converge at the crossing, with additional sets of flashers to warn all approaches.

Figure 2 shows a typical highway crossing signal equipped with a Type D gate mechanism, which provides reliable, high speed operation with a minimum of maintenance. It is capable of handling gate arms up to 38 feet in length with a maximum clearing time of 10 seconds. Wood gate arms are available in lengths up to 38 feet; fiberglass arms, up to 32 feet.

Highway crossing signal assemblies include a 4- or 5-inch diameter aluminum pole, cast aluminum junction box base, cast aluminum crossarm with LEX-C flashers (8 or 12 inch), and signs constructed of reflective sheeting permanently bonded to an aluminum base.

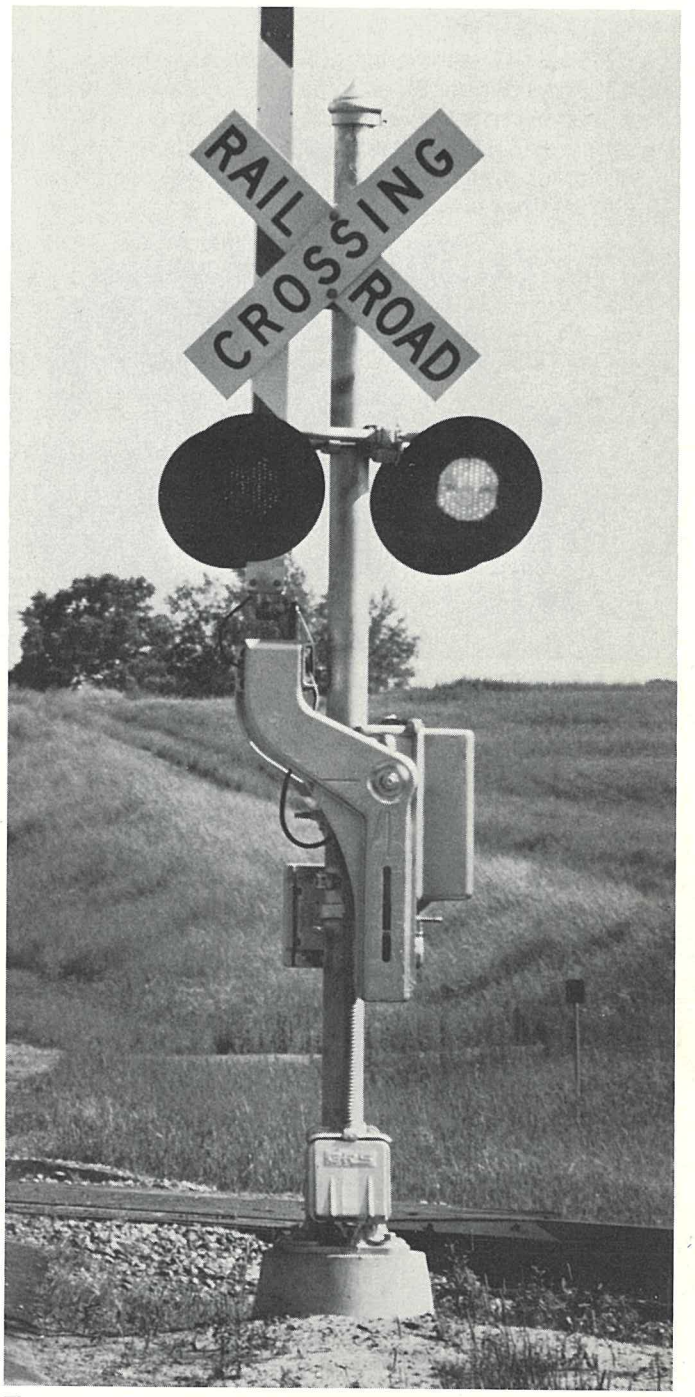


Figure 2. Highway crossing signal equipped with a Type D gate mechanism.

Flashing Light Units

The GRS LEX-C flashing light units, available in both 8″ and 12″ sizes (Figure 3), are made of polycarbonate resin which maintains its high impact strength even at low temperatures. LEX-C signals resist cracking or shattering under impact; there is no glass to smash. They are impervious to weather and resist vandalism.

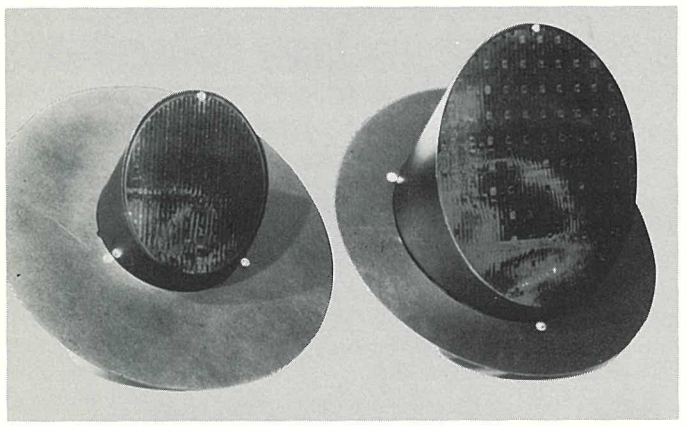


Figure 3. LEX-C flashing light units.

The high efficiency optics of the 8″ LEX-C include a reflector and lens area which are 50% larger than conventional crossing signals. Using a 10 volt, 18 watt lamp calibrated for 250 lumen output, a main beam of more than 3400 candlepower for the 8″ LEX-C and more than 5000 candlepower for the 12″ LEX-C is produced by a single lens, incorporating front light, back light, and cantilever patterns. An optional Phankill is available for installation where sunlight causes beam dilution.

LEX-C signals are 80% lighter in weight than conventional metal units. The light weight makes installation much easier as does having only two wire connections (for either Faston or AAR terminals) and a prefocused lampholder. Also, they have only a fraction of the parts of a conventional signal, hence a lower parts inventory is possible.

Conventional GRS Type XC crossing signals can be retrofitted with 8″ LEX-C lens assemblies to provide the benefits of LEX-C lens design at a reasonable cost.

Type D Crossing Gate Mechanism

Prelubricated, shielded or sealed bearings are used throughout the mechanism. The only lubrication required is the occasional application of grease to the gear teeth.

The mechanism is designed for low-voltage, d-c operation. The gate arm is raised from the horizontal to the clear position by means of a motor and gear train, Figure 4. Continuous protection is assured by a hold-clear magnet and associated locking device which holds the gate arm in the clear position as long as the supply energy is present. The approach of a train deenergizes the hold clear magnet and the gate arm descends by gravity.

To speed initial descent and to counter unusual conditions such as strong adverse winds, a combination of dynamic snub and power drive is utilized until the gate arm descends to a position 50 degrees from horizontal. From this position, the counterweighted gate arm descends by gravity. The rate of descent is retarded by dynamic snubbing.

Available as options are a digital counter to record the number of gate operations, a heater, and a sidewalk arm conversion kit.

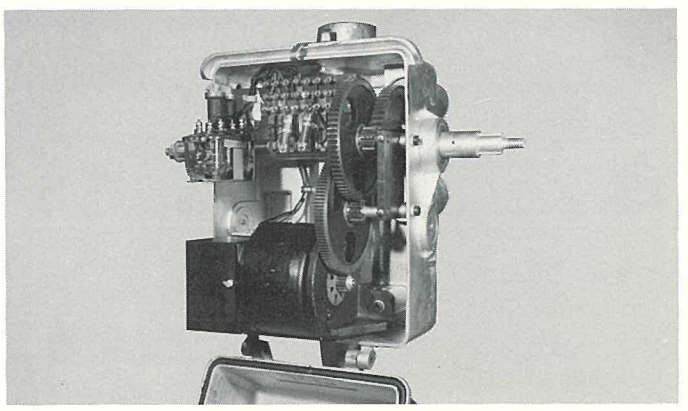


Figure 4.

Equipment Cases

GRS equipment cases offer a great variety of adjustable fixtures to permit arranging equipment to fit the needs of a particular highway crossing. These cases are available in either maintenance free aluminum or corrosion resistant, welded steel.

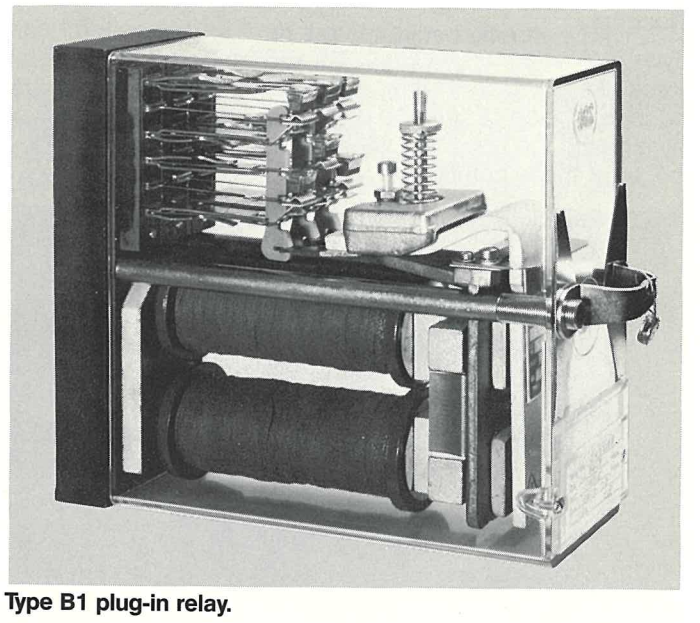
High single steel instrument case.

Permanently installed keyhole channels in the sides of the case provide for mounting shelves, backboards, and relay support bars for the best arrangement of the relays, batteries, transformers, rectifiers, etc.

For more information about GRS equipment cases, see GRS Assemblies Catalog, Section 5.

Plug-In Relays

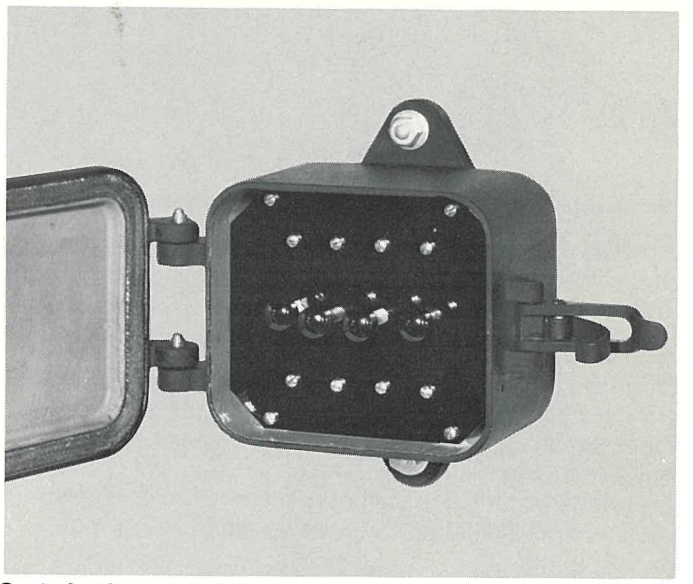
GRS Type B vital relays are designed for plug-in mounting on individual plugboards which are rack-installed in the equipment case. For more information, see GRS Catalog 62-1 and Pamphlet 1457.



Type B1 plug-in relay.

Test Box

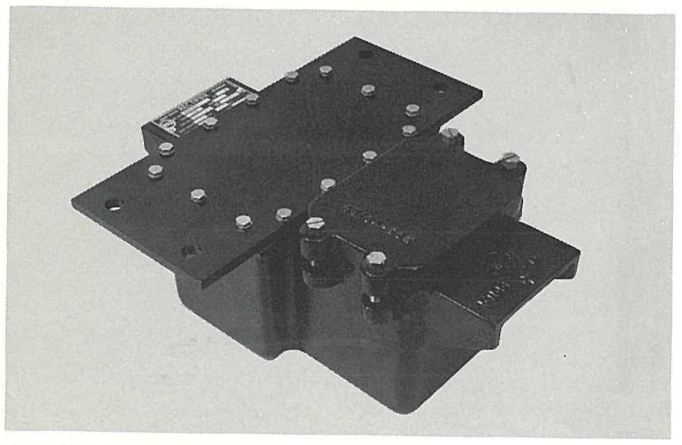
An optional test box is available for mounting on the equipment case or other convenient location. Switches, mounted in this weatherproof cast aluminum box, provide an easy way of checking the operation of the crossing warning devices.



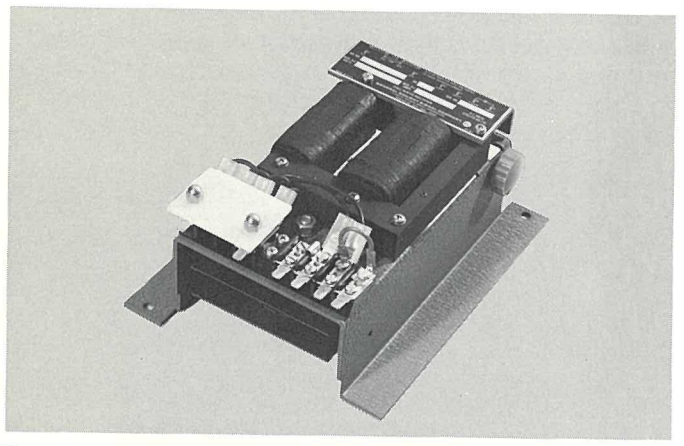
Cast-aluminum test box.

Rectifiers

Type SVA selenium rectifiers are used with a-c rectified track circuits. One rectifier is located at the far end of each approach circuit and one in the island circuit, thus eliminating the need for batteries, line drops, and battery boxes at these points.



Type SVA track rectifier.



Type ST selenium rectifier.

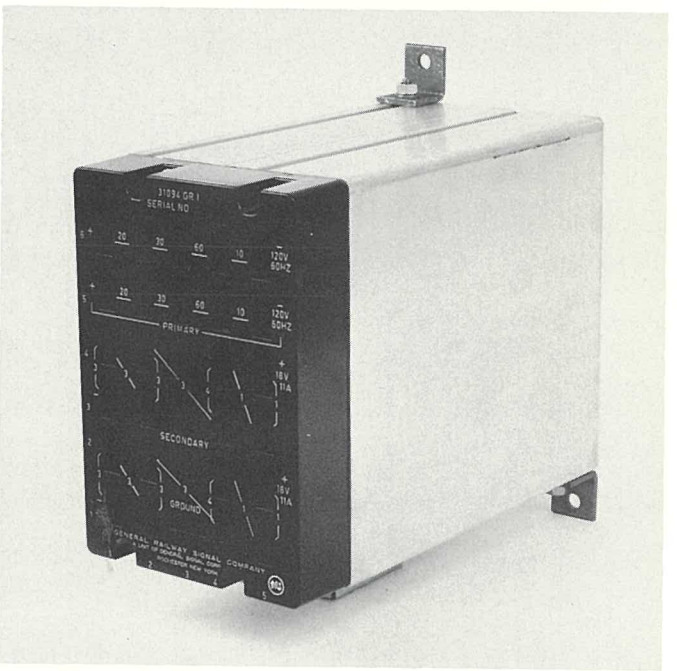
A GRS Type ST selenium rectifier is used for charging the standby batteries. It operates at uniform high efficiency over wide load variations, requires little maintenance, and takes up very little space. The rectifier has an adjustable, reactive transformer which provides, by means of a micrometer screw adjustment of the laminated yoke, an easy and gradual adjustment of the charging current.

For more information about GRS rectifiers, see GRS Assemblies Catalog, Section 53.

Transformer

The GRS Type UT transformer is engineered to provide years of trouble-free service, complete reliability, and a minimum of maintenance. It is designed expressly for use in railway signaling circuits.

The Type UT is an air-cooled transformer which has high insulation strength and provides good regulation with low core loss. It is wound to Association of American Railroad Signal Section Specifications. For more information, see GRS Catalog 95-1.



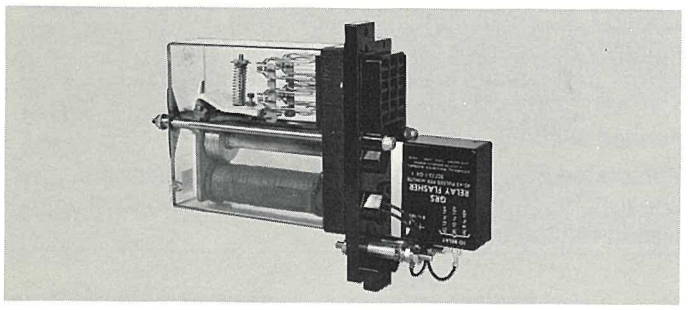
Type UT air-cooled transformer.

Flasher Module and Relay

The electronic flasher module mounts on the back of the Type B relay plugboard. The module uses the latest component technology which provides a high level of reliability and enables it to withstand surges of at least 1500 volts d-c.

The module, enclosed in a high impact-resistant poly-carbonate case and cover, drives its associated neutral relay at a constant flashing rate of 48 to 54 flashes per minute through a voltage range of 8 to 16 volts d-c. The flashing rate is determined solely by the circuit constants of the module and is not affected by the relay—there is nothing to adjust.

Two input terminals provide the means of mechanically mounting and electrically coupling the module to the relay. The relay has a single operating coil for rapid pickup, and four dependent, front-back, heavy-duty, nonfusing lamp control contacts.



Type B1 flasher relay.

Approach FSO

GRS approach Frequency Shift Overlay (FSO) track circuits provide high noise immunity train detection for highway crossing protection, without using insulated joints, on single or multiple track with single or double-direction traffic. Approach FSO track circuits can be up to 6000 feet long.

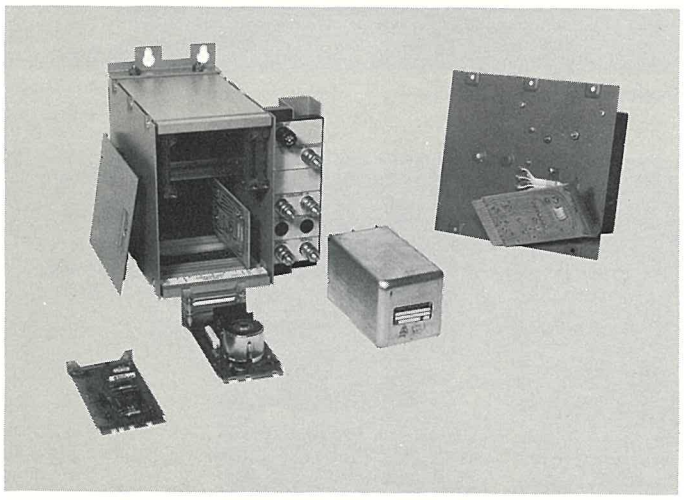
FSO equipment is available for 15 mutually compatible operating frequency channels. These frequencies reduce the possibility of interference from harmonics of power line frequencies, or from the combined effects of power line harmonics and other FSO equipment.

The FSO equipment for a basic track circuit consists of a transmitter, receiver, and biased-neutral track relay. Options include: a capacitor kit and a power amplifier for use under unusual noise conditions, facilities for centralized operation over line wires, and an insulated joint bypass unit.

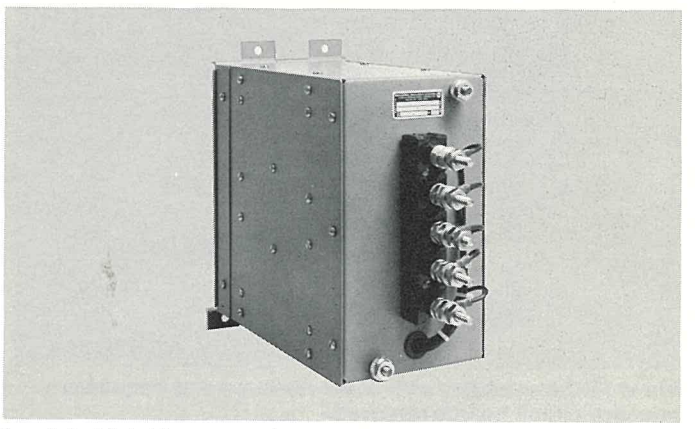
The optional insulated joint bypass unit effectively passes approach FSO frequencies around insulated joints, with a small reduction (typically 20%) in track circuit length. It has a minimum attenuation of 20 db at 100 Hz. The unit can be rack mounted or wall mounted.

The weatherproof remote coupling case comes wired complete with lightning and surge protection equipment.

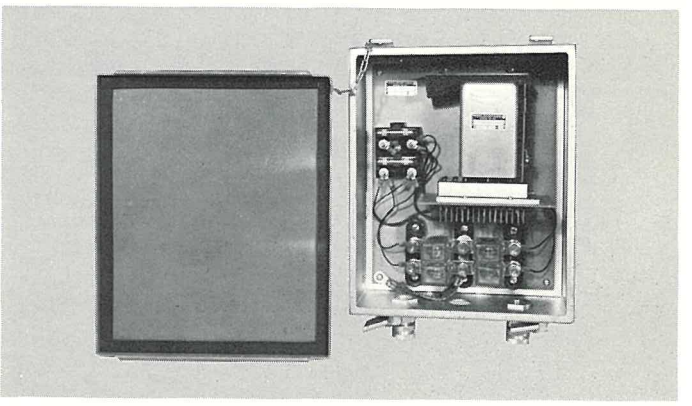
For more information about approach FSO, see GRS Catalog 92-2 and GRS Pamphlet 1416.



Approach FSO transmitter, with cover removed to show plug-in, modular design. To alter frequency, only the three starred items are changed. The power amplifier, an option, is shown on the right.



Insulated joint bypass unit.



Remote coupling case.

Island FSO

GRS island Frequency Shift Overlay (FSO) track circuit equipment is similar to that used for GRS approach frequency shift overlay (FSO) track circuits, except that it is available in three higher frequencies. These frequencies, ideal for short track circuits, provide high shunting sensitivity.

The three mutually compatible frequencies are also compatible with the fifteen frequencies available with approach FSO equipment.

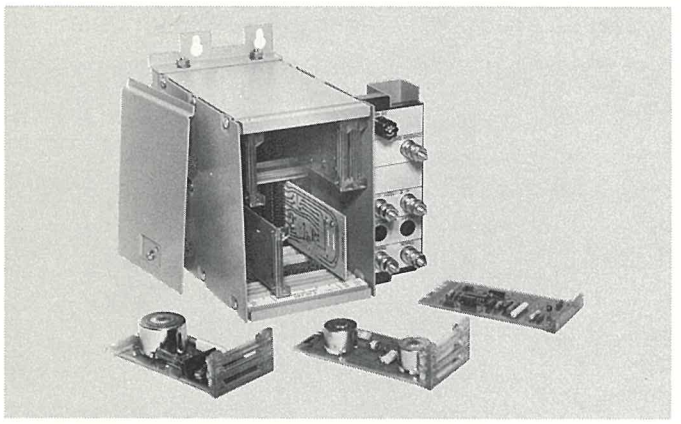
The equipment for an island FSO track circuit consists of a solid-state transmitter and receiver, and a biased neutral track relay. For more information, see GRS Catalog 92-2 and GRS Pamphlet 1503.

Coded FSO

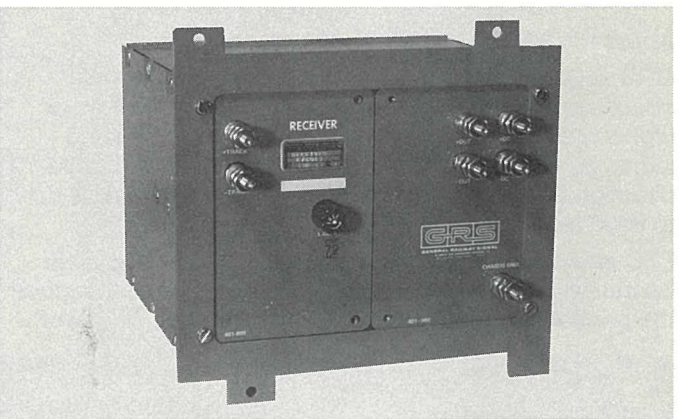
GRS coded frequency shift overlay (FSO) track circuits are used at highway crossings in electric propulsion territory. These circuits, similar to standard FSO track circuits, provide additional security against transient interference.

Coded FSO equipment is available with a choice of six mutually compatible operating frequency channels. The carrier frequencies are frequency shift coded at a rate of 120, 180, 270, or 410 pulses per minute to provide the needed security.

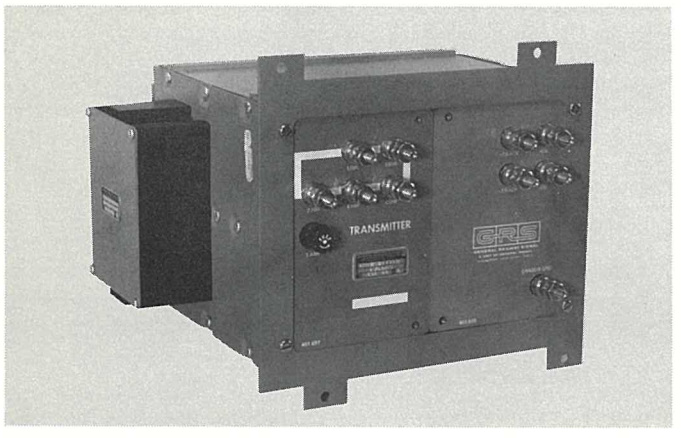
The coded FSO equipment for a basic track circuit consists of a transmitter, receiver, passive decoders, and biased-neutral track relay.



Island FSO transmitter, with cover removed and frequency selective circuit boards removed.



Coded FSO receiver.



Coded FSO transmitter.

Coded FSO decoder.

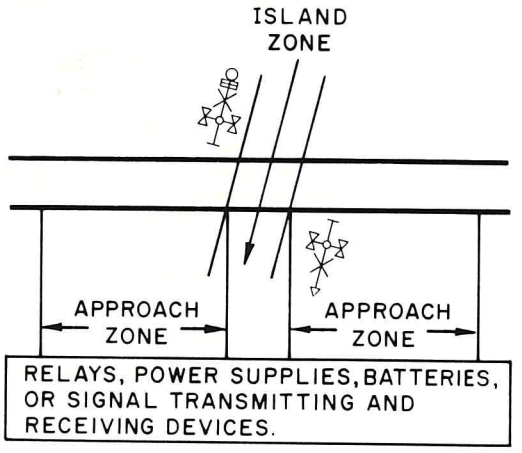
PRINCIPLES OF TRAIN DETECTION AND CONTROL CIRCUITRY

Although highway crossing warning circuits must be based on approved principles of operation, they are subject to a wide range of variations. It is often necessary to design the control circuits in accordance with local conditions of track layout, highway configurations, nature of available power supply, type of other signaling which may be in service in the area, character of rail traffic (for example, substantial variations in speeds of trains using the crossing, switching moves in the area, diesel or electric propulsion, etc.) pedestrian traffic, and other variables.

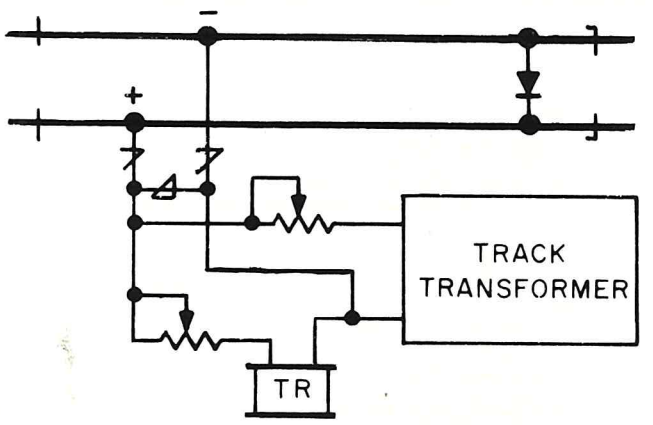
The crossing area is divided into zones for control purposes. A track circuit in each of these zones provides for train detection. Approach track circuits (see upper left diagram) start the warning devices—lights flashing at 48-54 FPM, bells ringing, and gates driven down. This is done by shunting energy, or a signal, in the rails, thereby deenergizing the track relay which, in turn, deenergizes the crossing relay and energizes the flasher relay.

An island circuit establishes a more positive directional control and deactivates the warning devices when the last car of the train clears the highway crossing.

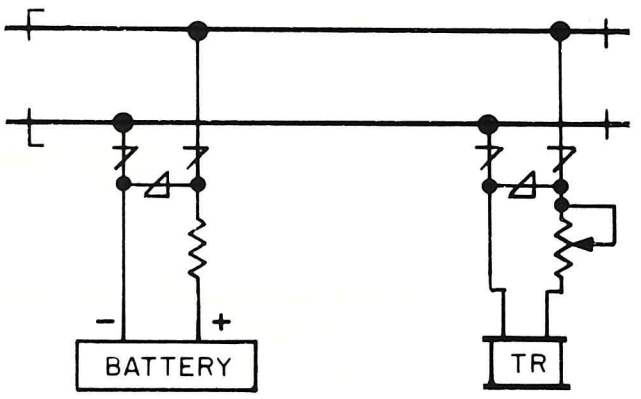
Simplified diagrams of three basic types of track circuits used for train detection at highway crossings are shown below.



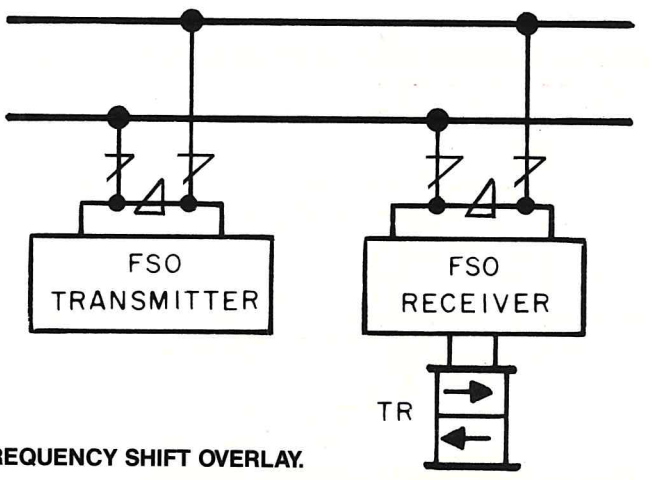
ISLAND ZONE



A-C RECTIFIED.



DIRECT CURRENT.



FREQUENCY SHIFT OVERLAY.

Lamp Lighting

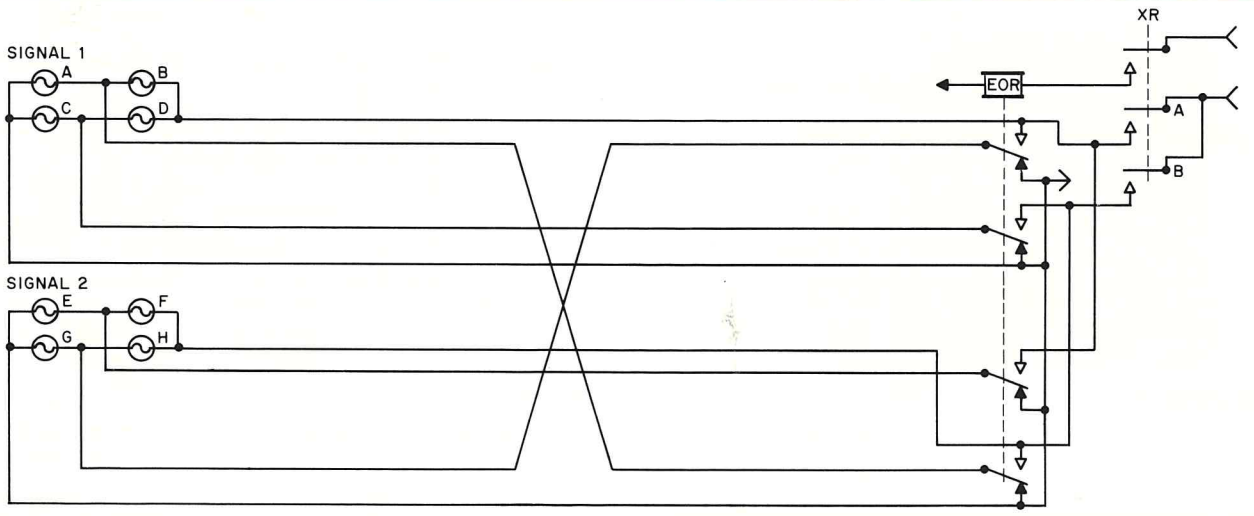
A signal rectifier provides a source of 10 volts d-c from 110 volts a-c, which is used to light the flasher lamps as well as charge the storage battery. Thus, lights are lit directly from the battery during a failure of commercial power.

Directional Control

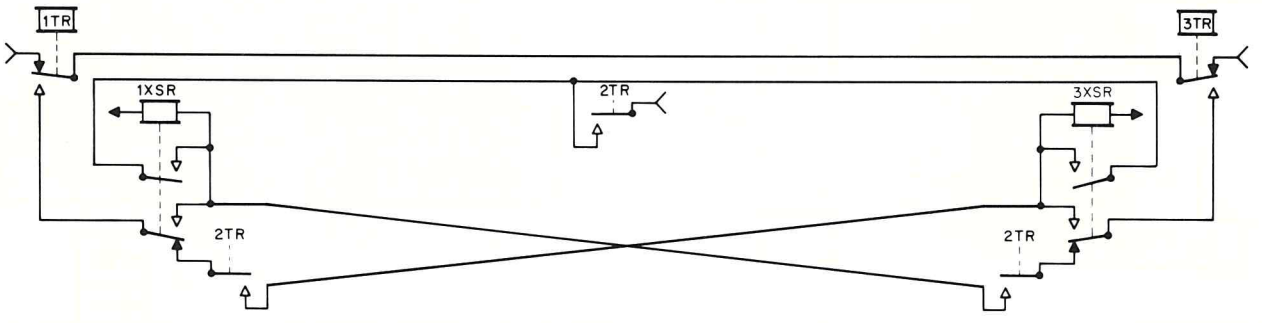
By the use of a third, or island, track circuit and directional stick relays, more positive directional control is established. The island track circuit provides a confirmation of track occupancy as first established by entry of a train into the approach section. If, for any reason, the approach circuit should fail to detect the train and activate the warning devices, the train can slowly enter the island detection area, activate the devices, and then proceed through the crossing area. The devices stop when the rear of the train clears the crossing.

Power

Storate battery capacity is maintained by a battery charger so that when the commercial power fails, the d-c and FSO track circuit systems and warning devices are completely supported by the standby battery until commercial power is restored. With a-c rectified (Type C) track circuits, the failure of commercial power results in an activation of the lights and bells, on a continuous basis, and gates are driven down where they remain until power is restored. In all installations, periodic maintenance of batteries and checks of power status are recommended.



TYPICAL FLASHING LIGHT CONTROL CIRCUIT.



TYPICAL DIRECTIONAL CONTROL CIRCUIT.

TYPICAL ARRANGEMENTS

The typical arrangements of highway crossing warning equipment, shown below, use various track circuits for train detection and warning device control.

A-c Rectified (Type "C")

This arrangement, primarily for private and nonsignaled crossings, uses a-c rectified track circuits. All equipment, except a small wayside package at the start of each approach, is housed at the crossing. During commercial power failures, a 10-volt circuit is provided for automatic and continuous operation of the audible and visual devices, which serves as a notification that the failure has occurred.

A-c Rectified with D-c Island

This arrangement is similar to a-c rectified, as described above, except for a d-c island section.

Direct Current

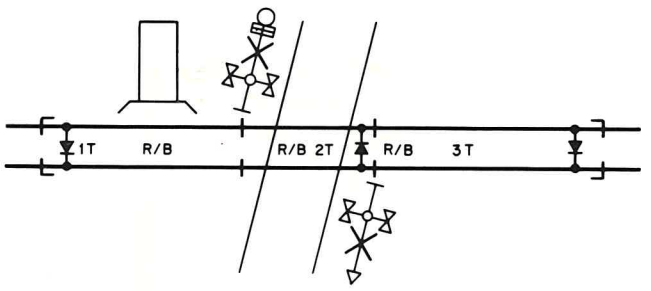
This arrangement, for railroads equipped with automatic block signals, uses d-c track circuits, which require additional insulated joints and rail bonding. All equipment, except track battery, is housed at the crossing.

Frequency Shift Overlay

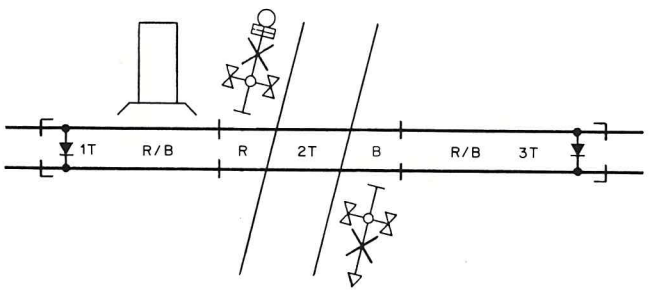
These arrangements, for railroads equipped with automatic block signals, use FSO track circuits, which do not require insulated joints. All equipment, except a small coupling unit, is housed at the crossing.

The FSO transmitters can be housed in separate cases at the approaches to the crossing.

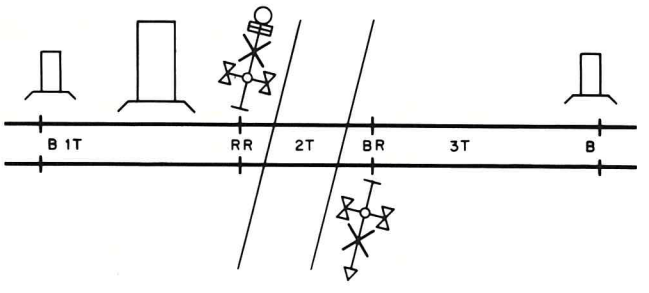
A-C RECTIFIED (TYPE "C")



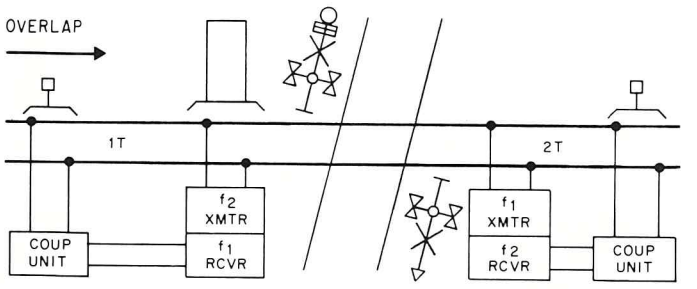
A-C RECTIFIED WITH D-C ISLAND

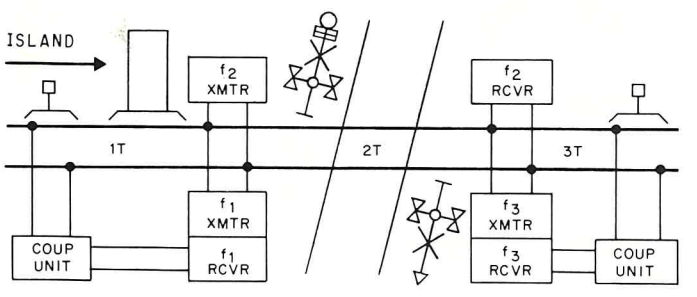


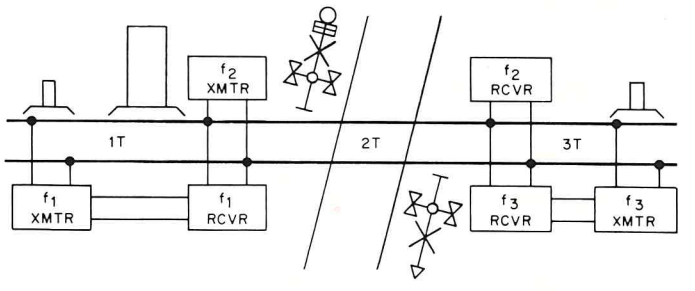
DIRECT CURRENT



FREQUENCY SHIFT OVERLAY

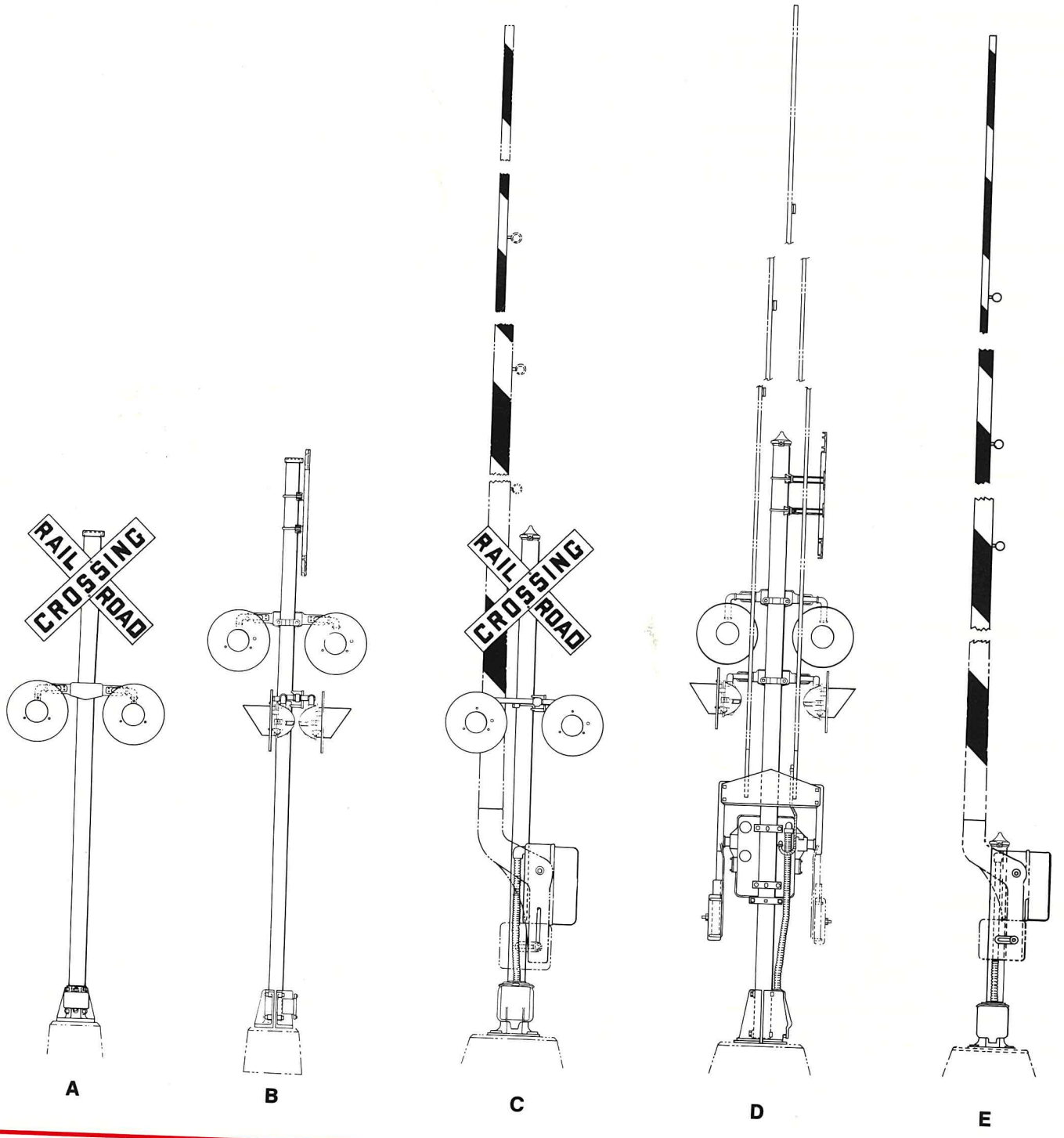






ORDERING INFORMATION

The ordering information contained on these pages is for basic signal assemblies and accessories. For special assemblies, please order from the GRS Parts List Catalog, Section P30.



A B C D E

SIGNAL ASSEMBLIES

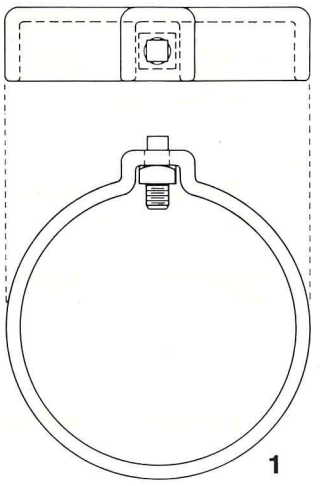
Basic signal assemblies (shipped unassembled) INCLUDE the parts listed below. The assemblies DO NOT INCLUDE the following; please order separately:

- **Bell and Phankill; see page 15.**
- **Track sign; see page 15.**
- **Gate Arm Assembly; see page 17.**
- **Test Box; see pages 20 and 22.**

PLEASE ORDER BY CATALOG NUMBER AND NAME SHOWN IN BOLD TYPE

REFERENCE	NAME	CATALOG NUMBER With 8″ LEX-Cs	CATALOG NUMBER With 12″ LEX-Cs
A	**BASIC SIGNAL ASSEMBLY** 4″ dia. x 13′ high aluminum pole with cap, crossing sign, junction box base, and crossarm with four LEX-C flashing light units with 10V, 18W lamps	**A30-500**	**A30-920**
A1	**BASIC SIGNAL ASSEMBLY** same as A except crossarm with two flashing light units	**A30-501**	**A30-921**
B	**BASIC SIGNAL ASSEMBLY** 4″ dia. x 15′ high aluminum pole with cap, crossing sign, junction box base, and two crossarms each with four LEX-C flashing light units with 10V, 18W lamps.	**A30-502**	**A30-922**
B1	**BASIC SIGNAL ASSEMBLY** same as B except upper crossarm with two flashing light units	**A30-503**	**A30-923**
C	**BASIC SIGNAL ASSEMBLY** for crossing gate, 5″ dia. x 13′ high aluminum pole with pinnacle, crossing sign, junction box base, crossarm with four LEX-C flashing light units with 10V, 18W lamps, and Type D gate mechanism only	**A30-504**	**A30-924**
C1	**BASIC SIGNAL ASSEMBLY** same as C except crossarm with two flashing light units	**A30-505**	**A30-925**
C2	**BASIC SIGNAL ASSEMBLY** same as C except without gate mechanism	**A30-506**	**A30-926**
C3	**BASIC SIGNAL ASSEMBLY** same as C except crossarm with two flashing light units and without gate mechanism	**A30-507**	**A30-927**
D	**BASIC SIGNAL ASSEMBLY** for crossing gate, 5″ dia. x 16′ high aluminum pole with pinnacle, crossing sign, junction box base, two crossarms, each with four LEX-C flashing light units with 10V, 18W lamps, and Type D gate mechanism only	**A30-508**	**A30-928**
D1	**BASIC SIGNAL ASSEMBLY** same as D except upper crossarm with two flashing light units	**A30-509**	**A30-929**
D2	**BASIC SIGNAL ASSEMBLY** same as D except without gate mechanism	**A30-510**	**A30-930**
D3	**BASIC SIGNAL ASSEMBLY** same as D except upper crossarm with two flashing light units and without gate mechanism	**A30-511**	**A30-931**
E	**CROSSING GATE ONLY ASSEMBLY** 5″ dia. x 6′ high aluminum pole with pinnacle, junction box base, and Type D gate mechanism only	**A30-512**	

ACCESSORIES FOR SIGNAL ASSEMBLIES



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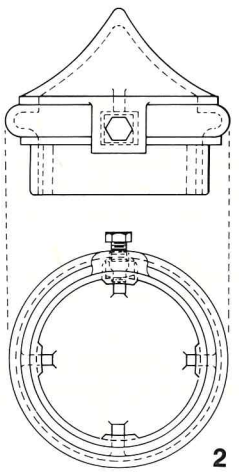

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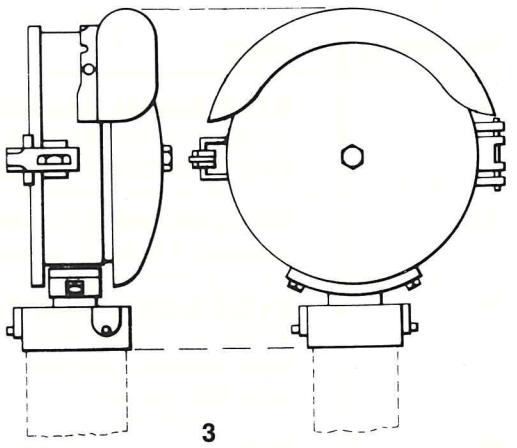

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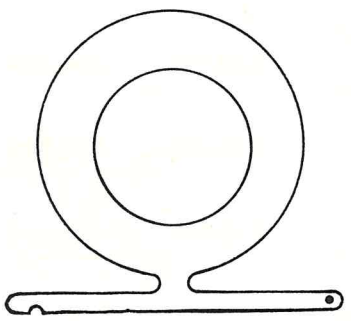

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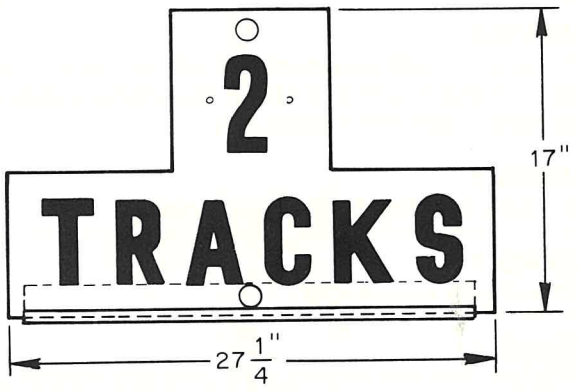

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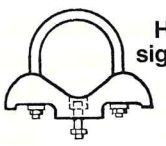
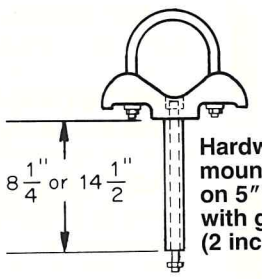
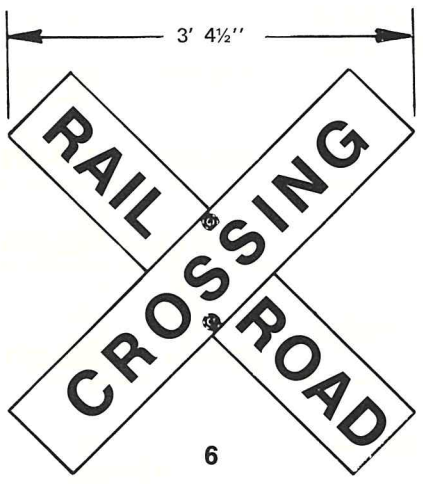


Hardware for mounting signs on 4″ or 5″ dia. pipe (2 included).



Hardware for mounting signs on 5″ dia. pipe with gate arm (2 included).



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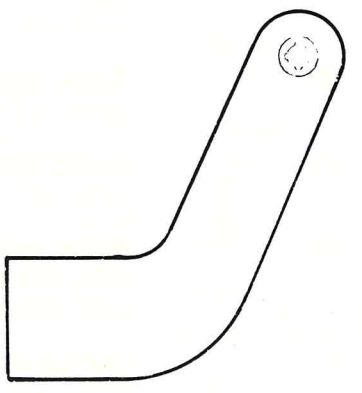
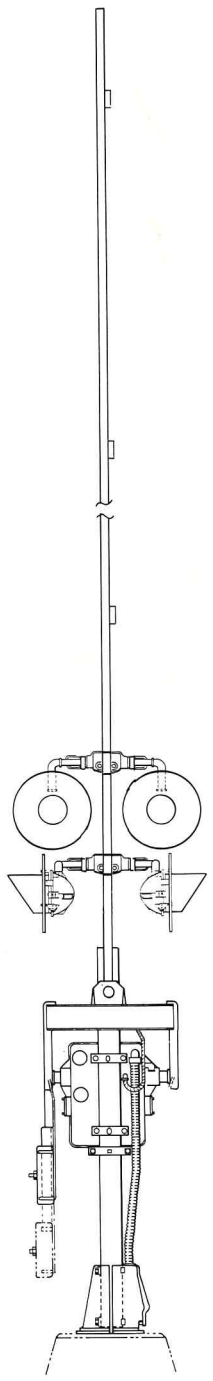


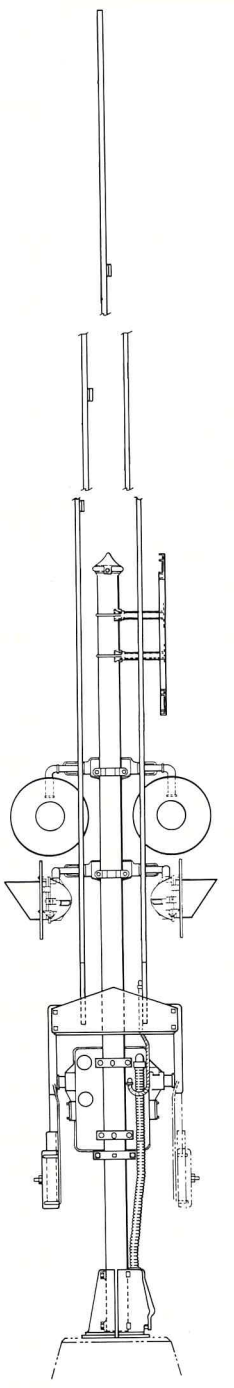
8

PLEASE ORDER BY CATALOG NUMBER AND NAME SHOWN IN BOLD TYPE

REFERENCE NUMBER	NAME	CATALOG NUMBER
1	**FLAT CAP** for 4″ dia. pole	**A30-520**
2	**PINNACLE CAP** for 5″ dia. pole	**A30-521**
3	**BELL** for 4″ dia. pole	**A30-522**
3a	Same as above, except for 5″ dia. pole	**A30-523**
4	**PHANKILL** for newer style 8″ LEX-C units with two point lamp suspension, includes mounting hardware	**A30-937**
4a	Same as above, except for older style units with single point lamp suspension	**A30-935**
4b	Same as above except for 12″ LEX-C units	**A30-936**
5	**TRACK SIGN** 2 tracks, with mounting hardware for 4″ dia. pole	**A30-558**
5a	Same as above, except for 5″ dia. pole	**A30-559**
5b	**TRACK SIGN** 3 tracks, with mounting hardware for 4″ dia. pole	**A30-560**
5c	Same as Ref 5b, except for 5″ dia. pole	**A30-561**
5d	**TRACK SIGN** 4 tracks, with mounting hardware for 4″ dia. pole	**A30-562**
5e	Same as Ref 5d, except for 5″ dia. pole	**A30-563**
5f	**TRACK SIGN** 5 tracks, with mounting hardware for 4″ dia. pole	**A30-564**
5g	Same as Ref 5f, except for 5″ dia. pole	**A30-565**
5h	**TRACK SIGN** 6 tracks, with mounting hardware for 4″ dia. pole	**A30-566**
5i	Same as Ref 5h, except for 5″ dia. pole	**A30-567**
6	**RAILROAD CROSSING SIGN** with mounting hardware for 4″ dia. pole	**A30-552**
6a	Same as above, except for 5″ dia. pole	**A30-553**
7	**RAILWAY CROSSING SIGN** with mounting hardware for 4″ dia. pole	**A30-554**
7a	Same as above, except for 5″ dia. pole	**A30-555**
8	**ARM** sidewalk arm support	**A30-657**

ACCESSORIES
FOR SIGNAL ASSEMBLIES (Cont'd)



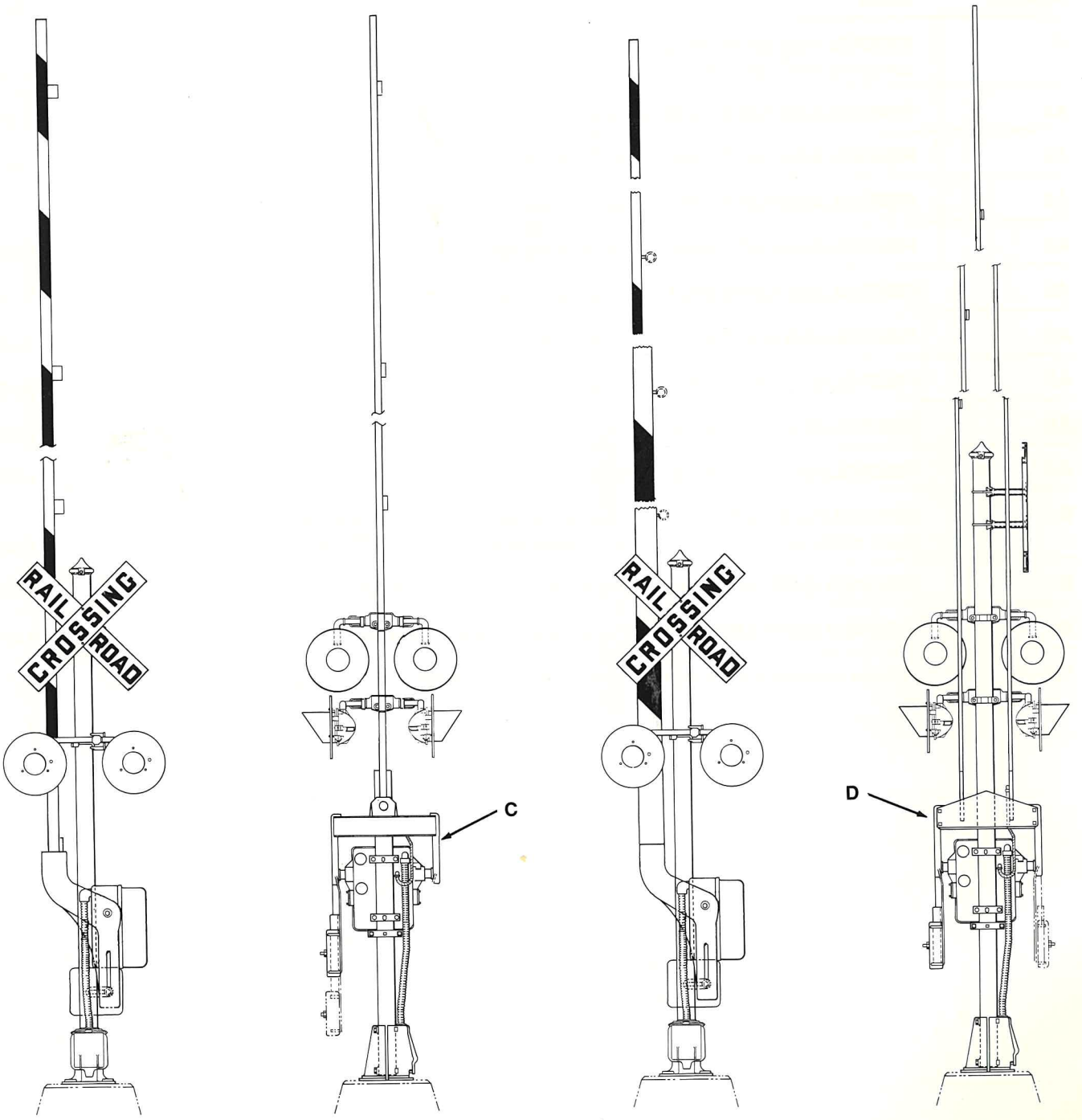


PLEASE ORDER BY CATALOG NUMBER AND NAME SHOWN IN BOLD TYPE

REFERENCE NUMBER	NAME	CATALOG NUMBER
A	**FIBERGLASS GATE ARM,** with red and white stripes of reflex-reflecting sheet material, complete with lights, 14′ long*	**A30-635**
A1	**FIBERGLASS GATE ARM,** same as A except 16′ long*	**A30-636**
A2	**FIBERGLASS GATE ARM,** same as A except 18′ long*	**A30-637**
A3	**FIBERGLASS GATE ARM,** same as A except 20′ long*	**A30-638**
A4	**FIBERGLASS GATE ARM,** same as A except 22′ long*	**A30-639**
A5	**FIBERGLASS GATE ARM,** same as A except 24′ long*	**A30-640**
A6	**FIBERGLASS GATE ARM,** same as A except 26′ long*	**A30-641**
A7	**FIBERGLASS GATE ARM,** same as A except 28′ long*	**A30-642**
A8	**FIBERGLASS GATE ARM,** same as A except 30′ long*	**A30-643**
A9	**FIBERGLASS GATE ARM,** same as A except 32′ long*	**A30-644**
B	**WOODEN GATE ARM,** with red and white stripes of reflex-reflecting sheet material, complete with lights, adjustable from 16′ to 22′ long*	**A30-630**
B1	**WOODEN GATE ARM,** same as B except adjustable from 24′ to 30′ long*	**A30-631**
B2	**WOODEN GATE ARM,** same as B except adjustable from 32′ to 38′ long*	**A30-632**

*Arm length is measured from centerline of signal mast with gate lowered—actual length of arm will be approx. 2 feet less.

ACCESSORIES
FOR SIGNAL ASSEMBLIES (Cont'd)



PLEASE ORDE

REFERENCE NUMBER
C
C1
C2
C3
C4
C5
C6
C7
C8
C9
D
D1
D2
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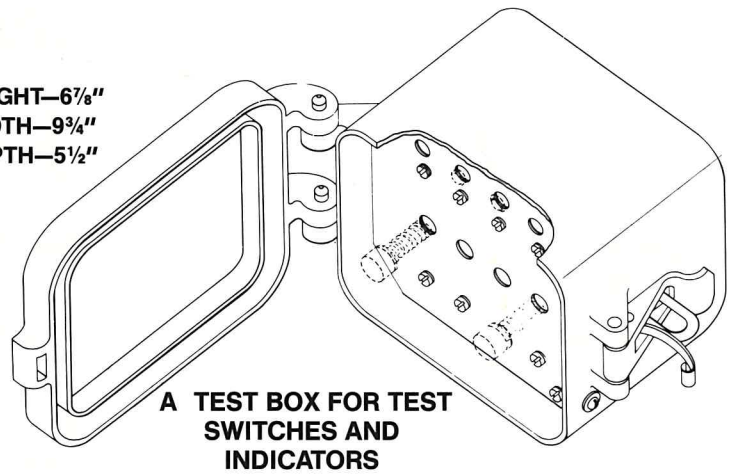
PLEASE ORDER BY CATALOG NUMBER AND NAME SHOWN IN BOLD TYPE

REFERENCE NUMBER	NAME	CATALOG NUMBER
C	**GATE ARM MOUNTING ASSEMBLY** for 14′ long fiberglass gate arm, complete with all counterweights and field hardware	**A30-670**
C1	**GATE ARM MOUNTING ASSEMBLY** same as C except for a 16′ long fiberglass gate arm	**A30-671**
C2	**GATE ARM MOUNTING ASSEMBLY** same as C except for an 18′ long fiberglass gate arm	**A30-672**
C3	**GATE ARM MOUNTING ASSEMBLY** same as C except for a 20′ long fiberglass gate arm	**A30-673**
C4	**GATE ARM MOUNTING ASSEMBLY** same as C except for a 22′ long fiberglass gate arm	**A30-674**
C5	**GATE ARM MOUNTING ASSEMBLY** same as C except for a 24′ long fiberglass gate arm	**A30-675**
C6	**GATE ARM MOUNTING ASSEMBLY** same as C except for a 26′ long fiberglass gate arm	**A30-676**
C7	**GATE ARM MOUNTING ASSEMBLY** same as C except for a 28′ long fiberglass gate arm	**A30-677**
C8	**GATE ARM MOUNTING ASSEMBLY** same as C except for a 30′ long fiberglass gate arm	**A30-678**
C9	**GATE ARM MOUNTING ASSEMBLY** same as C except for a 32′ long fiberglass gate arm and with extension arm	**A30-679**
D	**GATE ARM MOUNTING ASSEMBLY** for 16′ to 22′ adjustable wooden gate arm, complete with all counterweights and field hardware	**A30-683**
D1	**GATE ARM MOUNTING ASSEMBLY** same as D except for a 24′ to 30′ long adjustable wooden gate arm	**A30-684**
D2	**GATE ARM MOUNTING ASSEMBLY** same as D except for a 32′ to 38′ adjustable wooden gate arm	**A30-685**
—	**CONVERSION KIT** all parts necessary to convert Type D gate mechanism for use with a sidewalk arm	**A30-660**

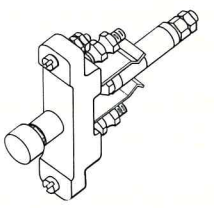
TEST BOXES

PLEASE ORDER BY CATALOG NUMBER AND NAME SHOWN IN BOLD TYPE

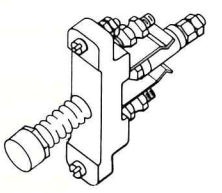
HEIGHT—6⅞″
WIDTH—9¾″
DEPTH—5½″



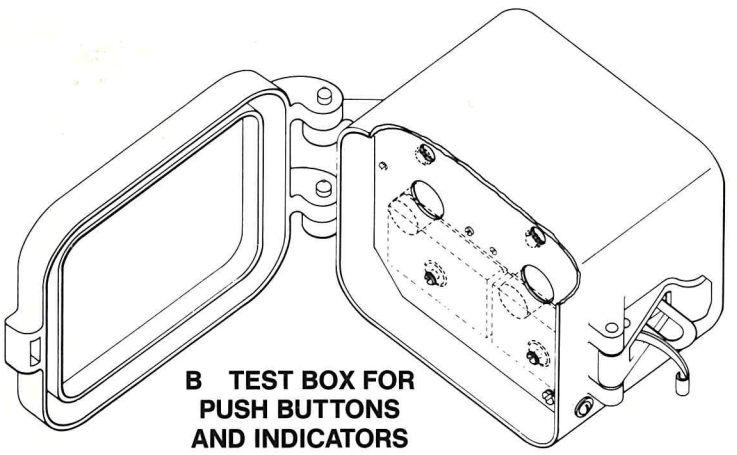
A TEST BOX FOR TEST SWITCHES AND INDICATORS



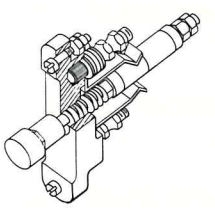
C TEST SWITCH PUSH-PULL TYPE



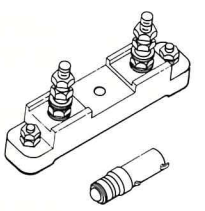
D TEST SWITCH PUSH TYPE SPRING RETURN



B TEST BOX FOR PUSH BUTTONS AND INDICATORS (MAX. 2 EACH)



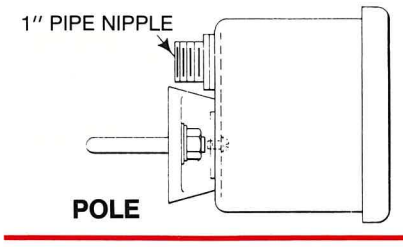
E TEST SWITCH PULL TYPE SPRING RETURN



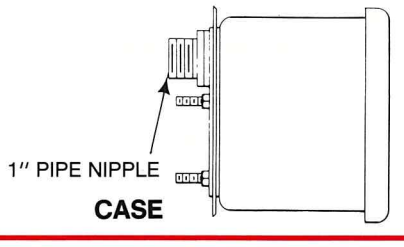
F LAMP SOCKET (INDICATOR) AND TERMINAL BLOCK

MAXIMUM CAPACITY OF LIGHTS AND SWITCHES		
REF.	LIGHTS	SWITCHES
A	2 — 4	2 4 —
B	2	2

MOUNTING METHODS

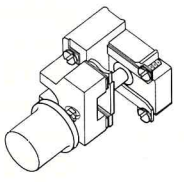


POLE



CASE

G LAMP SOCKET (INDICATOR)



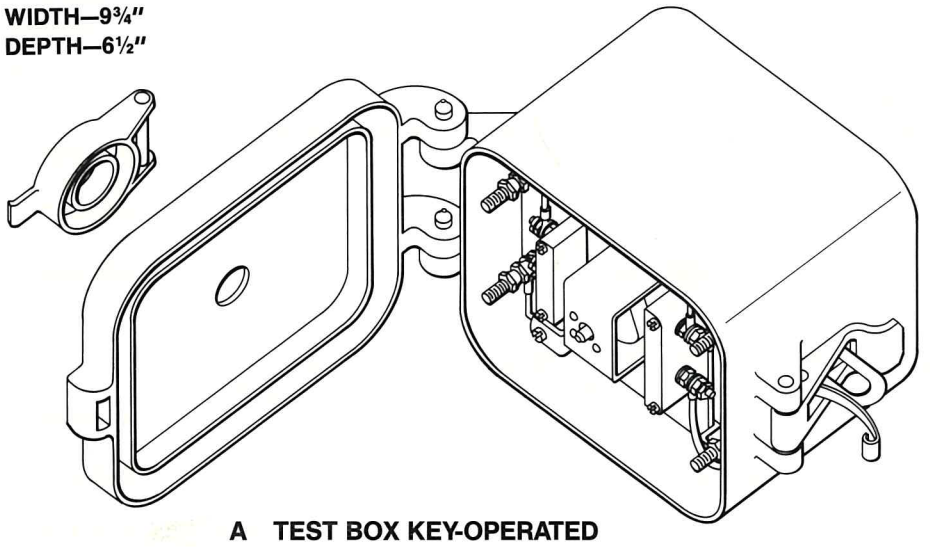
H PUSH BUTTON

PLEASE ORDER BY CATALOG NUMBER AND NAME SHOWN IN BOLD TYPE

REFERENCE	NAME	CATALOG NUMBER
A	**TEST BOX** for bolting on case. Panel drilled for test switches and indicating lamps. Order test switches and indicating lamps separately. Includes 1″ pipe nipple and all mounting hardware	**A30-400**
A1	As above, except for fastening to 4″ dia. pole	**A30-403**
A2	Same as above, except for fastening to 5″ dia. pole	**A30-404**
B	**TEST BOX** for bolting on case. Panel drilled for two push buttons and two indicating lamps. Order push buttons and indicating lamps separately. Includes 1″ pipe nipple and all mounting hardware	**A30-409**
B1	As above, except for fastening to 4″ dia. pole	**A30-412**
B2	Same as above, except for fastening to 5″ dia. pole	**A30-413**
C	**TEST SWITCH** push-pull type, fits test box, ref. A	**A30-418**
D	**TEST SWITCH** push-type spring-return, controlled by cover. Shown in cover-open position, fits test box, ref. A	**A30-420**
E	**TEST SWITCH** pull-type, spring-return, fits test box, ref. A	**A30-423**
F	**LAMP SOCKET** with red bullseye. Takes telephone type, slide base lamp, includes terminal block and connectors for use in text box, ref. A	**A30-426**
F1	As above, except with green bullseye	**A30-427**
F2	Same as above, except with white bullseye	**A30-428**
G	**LAMP SOCKET** with red bullseye. Takes telephone type, slide base lamp, includes connectors for use in text box, ref. B.	**A30-434**
G1	As above, except with green bullseye	**A30-435**
G2	Same as above, except with white bullseye	**A30-436**
H	**PUSH BUTTON** one contact normally open and one normally closed, includes all mounting hardware, fits test box, ref. B	**A30-431**

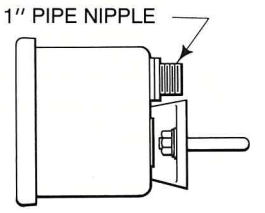
TEST BOXES (cont'd)

HEIGHT—6⅞″
WIDTH—9¾″
DEPTH—6½″

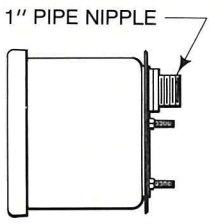


A TEST BOX KEY-OPERATED

MOUNTING METHODS



POLE



CASE

PLEASE ORDER BY CATALOG NUMBER AND NAME SHOWN IN BOLD TYPE

REFERENCE	NAME	CATALOG NUMBER Case Mounting	Pole Mounting 4″ Dia.	Pole Mounting 5″ Dia.
A	**TEST BOX, KEY-OPERATED** with two single-pole single-throw contacts operated by clockwise turn of standard railroad key.* Left contact normally closed; right contact normally open	**A30-450**	**A30-453**	**A30-454**
A1	As above, except both contacts normally closed	**A30-460**	**A30-463**	**A30-464**
A2	Same as above, except both contacts normally open	**A30-470**	**A30-473**	**A30-474**
A3	Same as above, except contacts operated both by clockwise and counterclockwise turn of key. Left contact normally closed; right contact normally open. In CW position, both contacts closed; in CCW position, both contacts open	**A30-480**	**A30-483**	**A30-484**
A4	Same as A3, except both contacts normally open. In CW position, left contact closed, right contact open. In CCW position, left contact open, right contact closed	**A30-490**	**A30-493**	**A30-494**

*Send sample or drawing of your key, if not previously supplied.

DESIGN QUESTIONNAIRE
RAIL-HIGHWAY GRADE CROSSING WARNING SYSTEM

Completion of this questionnaire will enable GRS engineers to process your inquiry/order and begin work on your crossing needs immediately.

In addition to this questionnaire, please provide a scaled track plan with all existing switches, signals, and/or any other electric/electronic device(s), and insulated joints. Orders, especially, should be provided with current tie-in plans.

Railroad or company name:_____ Date:_____

Operations:

1. Length of approaches_____
2. Speed of trains_____
3. Direction of traffic_____
4. Number of trains in 24 hours_____
5. Motive power: diesel_____ electric_____
   If electric, give particulars about voltage, frequency, return current through rails and whether track circuits are single or double rail.

   _____

   _____
6. Describe all special moves made or to be made in approaches, particularly over switches:

   _____

   _____

Track Circuit Preferred (check one):

1. _____ A-c rectified with island
2. _____ A-c rectified with d-c island
3. _____ D-c with island
4. _____ Frequency shift overlay (FSO)
   a. _____ Overlap _____ Island
   b. _____ Central _____ Remote transmitters
   c. If you have channel preferences please list frequencies:
      Track 1: _____ approach _____ approach _____ island
      Track 2: _____ approach _____ approach _____ island
      Additional tracks—list as above_____
   d. If there are existing electronic track circuits, please state frequencies:
      _____ _____ _____ and manufacturer_____
   e. Please list FSO options desired (See GRS Catalog 92-2):_____

      _____

      _____

(over)

Cases:

1. Size preferred_____ or GRS engineer's choice_____
2. Steel_____ aluminum_____
3. Prewired_____ unwired_____

Power:

1. Is 110V 60Hz available? _____ yes _____ no. If not, state power_____
2. Whatever your track circuit preference, please state if standby battery is required.

   _____ yes _____ no

   If yes, hours required _____
3. Nickel cadmium _____ lead acid _____
4. In case _____ separate box _____

Signal Assemblies:

1. Flashers only _____

   Flashers with gates: wood _____ fiberglass _____ length of gate _____

   NOTE: Wood gate arms are available up to 38 feet and fiberglass up to 32 feet.
2. Cantilever:

   Length of arm _____ ft fixed _____ adjustable _____

   Walkout _____ yes _____ no

   Locking guards for ladder _____ yes _____ no

   Unless otherwise requested, base mounting holes will be on 19-inch centers.
3. Signal units per main road arm _____ 2 _____ 4

   When required: signal units per roadway arm facing to left _____ or right _____

   Lamp: _____ voltage _____ wattage

   Lamp lit from _____ d-c _____ a-c
4. Signs: _____ railroad _____ railway crossing

   _____ 2 _____ 3 _____ 4 track _____ Other
5. Bell: _____ none _____ one _____ two

Test Box: _____ yes _____ no Where mounted?_____

Please include any pertinent information that will assist GRS with the design of your crossing system.

_____

_____

_____

_____

DESIGN QUESTIONNAIRE
RAIL-HIGHWAY GRADE CROSSING WARNING SYSTEM

Completion of this questionnaire will enable GRS engineers to process your inquiry/order and begin work on your crossing needs immediately.

In addition to this questionnaire, please provide a scaled track plan with all existing switches, signals, and/or any other electric/electronic device(s), and insulated joints. Orders, especially, should be provided with current tie-in plans.

Railroad or company name:_____ Date:_____

Operations:

1. Length of approaches_____
2. Speed of trains_____
3. Direction of traffic_____
4. Number of trains in 24 hours_____
5. Motive power: diesel_____ electric_____
   If electric, give particulars about voltage, frequency, return current through rails and whether track circuits are single or double rail.
   _____
   _____
6. Describe all special moves made or to be made in approaches, particularly over switches:
   _____
   _____

Track Circuit Preferred (check one):

1. _____ A-c rectified with island
2. _____ A-c rectified with d-c island
3. _____ D-c with island
4. _____ Frequency shift overlay (FSO)
   a. _____ Overlap _____ Island
   b. _____ Central _____ Remote transmitters
   c. If you have channel preferences please list frequencies:
      Track 1: _____ approach _____ approach _____ island
      Track 2: _____ approach _____ approach _____ island
      Additional tracks—list as above_____
   d. If there are existing electronic track circuits, please state frequencies:
      _____ _____ _____ and manufacturer_____
   e. Please list FSO options desired (See GRS Catalog 92-2):_____
      _____
      _____

(over)

Cases:

1. Size preferred_____ or GRS engineer's choice_____
2. Steel_____ aluminum_____
3. Prewired_____ unwired_____

Power:

1. Is 110V 60Hz available? _____ yes _____ no. If not, state power_____
2. Whatever your track circuit preference, please state if standby battery is required.

   _____ yes _____ no

   If yes, hours required _____
3. Nickel cadmium _____ lead acid _____
4. In case _____ separate box _____

Signal Assemblies:

1. Flashers only _____

   Flashers with gates: wood _____ fiberglass _____ length of gate _____

   NOTE: Wood gate arms are available up to 38 feet and fiberglass up to 32 feet.
2. Cantilever:

   Length of arm _____ ft fixed _____ adjustable _____

   Walkout _____ yes _____ no

   Locking guards for ladder _____ yes _____ no

   Unless otherwise requested, base mounting holes will be on 19-inch centers.
3. Signal units per main road arm _____ 2 _____ 4

   When required: signal units per roadway arm facing to left _____ or right _____

   Lamp: _____ voltage _____ wattage

   Lamp lit from _____ d-c _____ a-c
4. Signs: _____ railroad _____ railway crossing

   _____ 2 _____ 3 _____ 4 track _____ Other
5. Bell: _____ none _____ one _____ two

Test Box: _____ yes _____ no Where mounted?_____

Please include any pertinent information that will assist GRS with the design of your crossing system.

_____

_____

_____

_____

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A UNIT OF GENERAL SIGNAL

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Telex: 978317

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CHICAGO OFFICE
PRUDENTIAL PLAZA SUITE 2120 CHICAGO IL 60601 Phone: 312 • 467-1221

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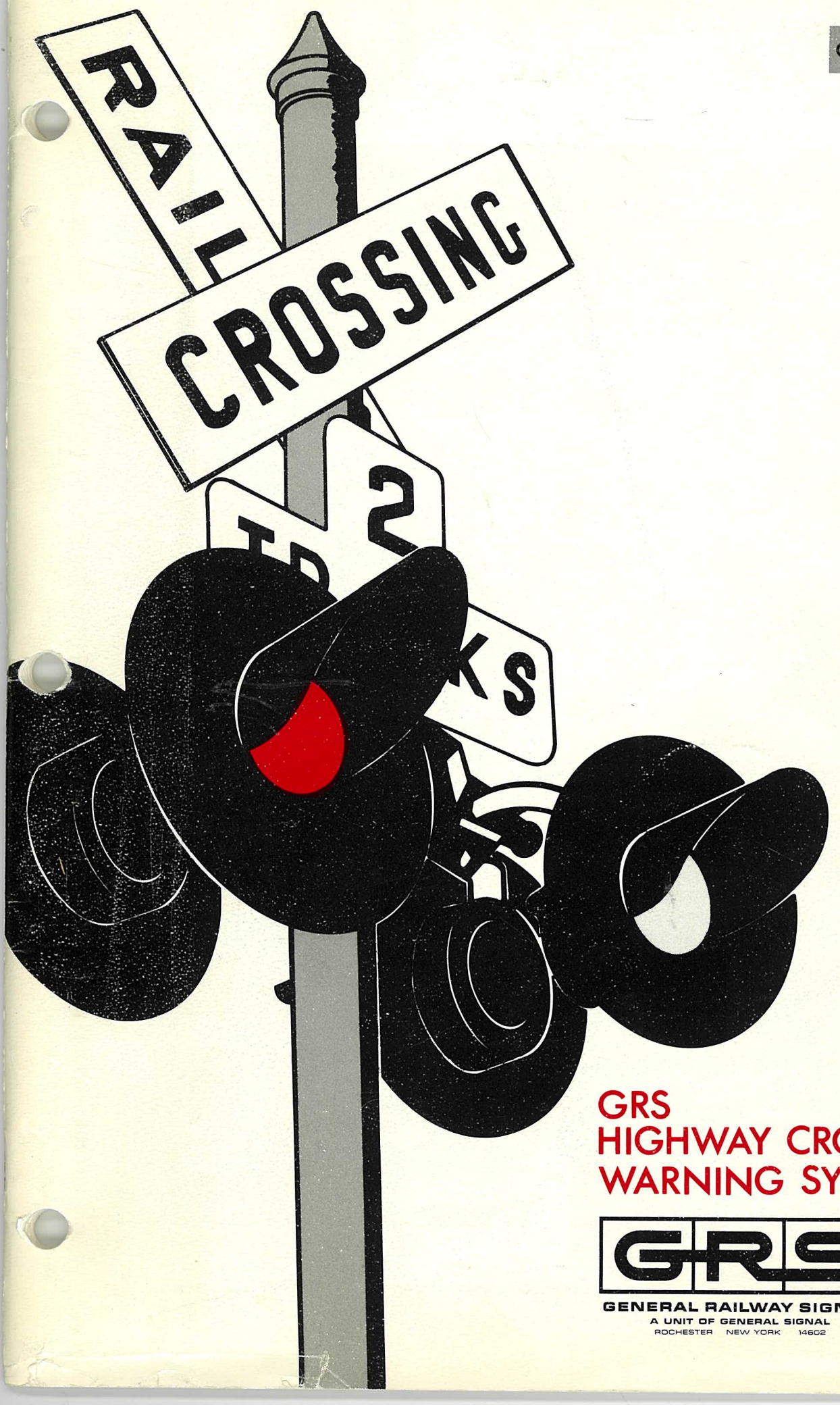
REPRESENTATIVES AND LICENSEES THROUGHOUT THE WORLD

1977

GRS CATALOG 30-1



GRS
HIGHWAY CROSSING
WARNING SYSTEMS

GRS

GENERAL RAILWAY SIGNAL

A UNIT OF GENERAL SIGNAL

ROCHESTER NEW YORK 14602

Contents

INTRODUCTION 2

PRINCIPLES OF TRAIN DETECTION AND CONTROL CIRCUITRY 3
- Lamp Lighting 4
- Directional Control 4
- Power 4

TYPICAL ARRANGEMENTS 5
- A-c Rectified (Type "C") 5
- A-c Rectified with D-c Island 5
- Direct Current 5
- Frequency Shift Overlay 5

SIGNAL ASSEMBLIES 6
- Type D Crossing Gate Mechanism 7
- Type XC Flashing Light Units 7

CASE WIRED EQUIPMENT 8
- Equipment Cases 8
- Plug-In Relays 8
- Test Box 8
- Rectifiers 9
- Transformers 9
- Flasher Module 10
- Approach FSO 10
- Island FSO 12

ORDERING INFORMATION 13
- Signal Assemblies 14
- Optional Equipment and Replacement Parts 16
- Pre-Engineered Cases 25
- Pre-Engineered System Order Form . . 29
- Design Questionnaire 31

Introduction

GRS products and systems have been engineered to meet the total requirements of your particular highway crossing problems. Pre-engineered warning systems for single and double track crossings, either where no warning equipment is currently provided or for upgrading existing installations, are available to fit most situations. Also, GRS is prepared to do custom application engineering for more complex designs that require special features and/or equipment, such as multiple track crossings and highway traffic signal preemption. Both are complete configurations of control circuitry, automatic train detection equipment, dual power considerations, lightning protection, and space for storage batteries in the cases.

All systems are designed around components of GRS manufacture and have proven reliability. Only reliable GRS plug-in vital relays, selenium rectifiers, and transformers are used. Unwired or completely prewired equipment cases are available. Signal assemblies are all aluminum with a wide variety of options, such as signs, bells, and roundels.

This publication contains typical arrangements to illustrate the basic principles and equipment used in this field and ordering questionnaires to assist you in ordering either a pre-engineered highway crossing system or a custom designed system which meets your particular highway crossing need. Also included is ordering information for standard signal assemblies (with or without gates) unwired and prewired equipment cases, and optional and replacement parts.

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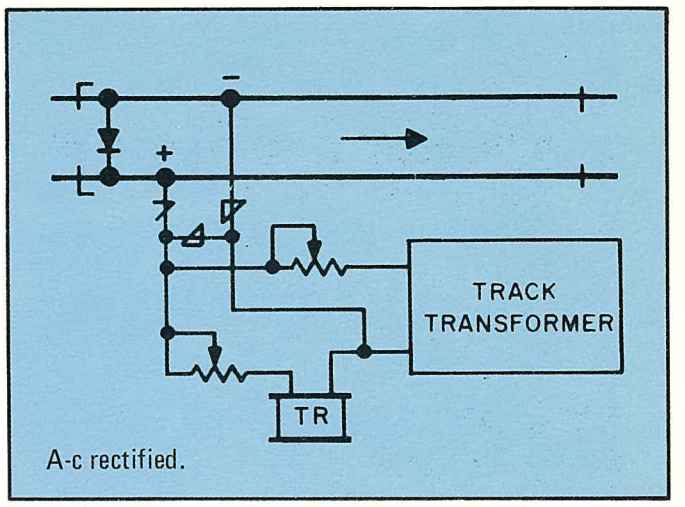
Principles of Train Detection and Control Circuitry

Although highway crossing warning circuits must be based on approved principles of operation, they are subject to a wide range of variations. It is often necessary to design the control circuits in accordance with local conditions of track layout, highway configurations, nature of available power supply, type of other signaling which may be in service in the area, character of rail traffic (for example, substantial variations in speeds of trains using the crossing, switching moves in the area, diesel or electric propulsion, etc.) pedestrian traffic, and other variables.

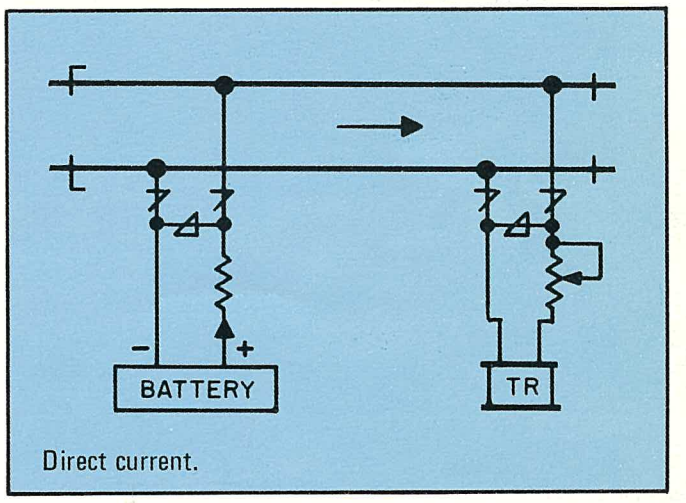
The crossing area is divided into zones for control purposes. A track circuit in each of these zones provides for train detection. Approach track circuits (see diagram below) start the warning devices — lights flashing at 40-45 FPM, bells ringing, and gates driven down. This is done by shunting energy, or a signal, in the rails, thereby deenergizing the track relay which, in turn, energizes the crossing relay and subsequently the flasher relay.

An island circuit establishes a more positive directional control and deactivates the warning devices when the last car of the train clears the highway crossing.

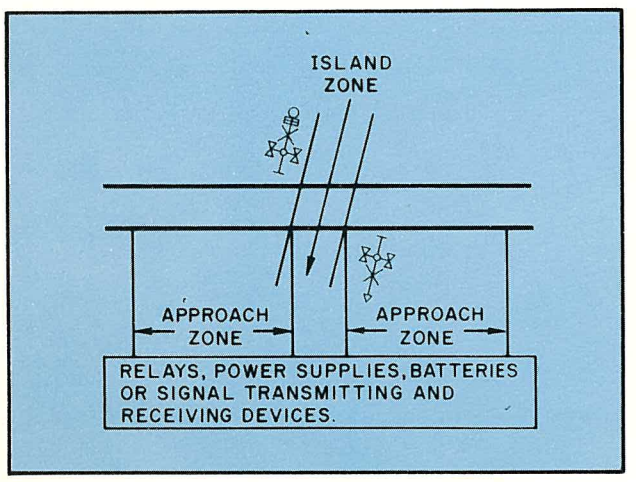
Simplified diagrams of three basic types of track circuits used for train detection at highway crossings are shown at the right.

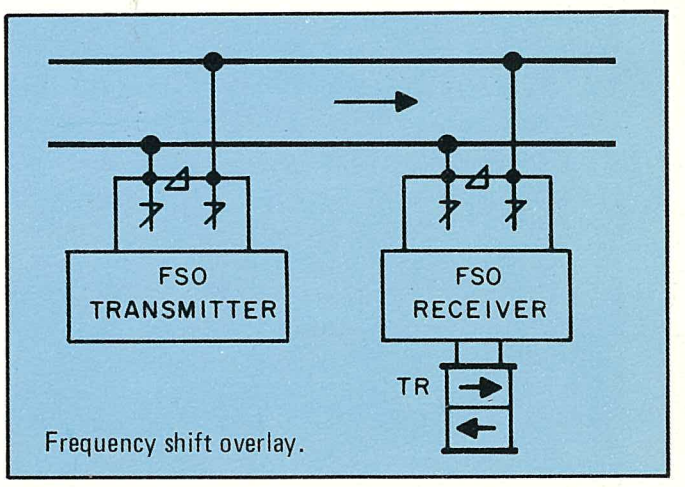


A-c rectified.



Direct current.

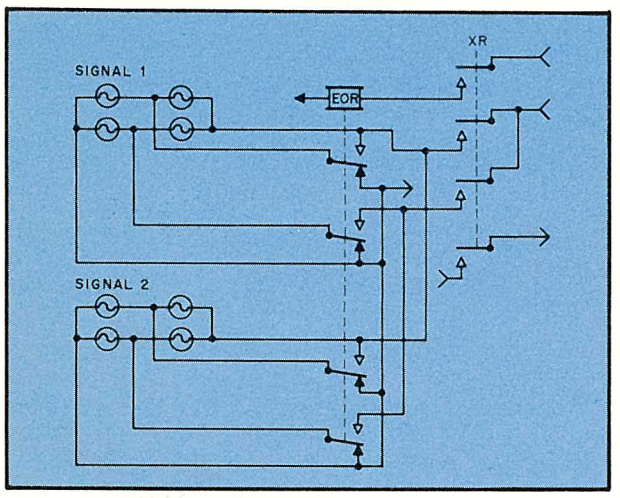




Frequency shift overlay.

Lamp Lighting

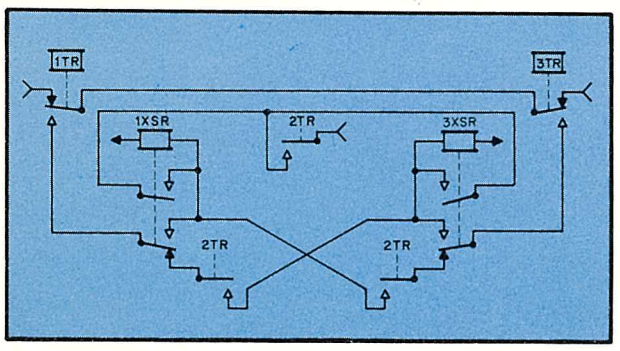
A signal rectifier provides a source of 10 volts d-c from 110 volts a-c, which is used to light the flasher lamps as well as charge the storage battery. Thus, lights are lit directly from the battery during a failure of commercial power.



Typical flashing light control circuit.

Directional Control

By the use of a third, or island, track circuit and directional stick relays, more positive directional control is established. The island track circuit provides a confirmation of track occupancy as first established by entry of a train into the approach section. If, for any reason, the approach circuit should fail to detect the train and activate the warning devices, the train can slowly enter the island detection area, activate the devices, and then proceed through the crossing area. The devices stop when the rear of the train clears the crossing.



Typical directional control circuit

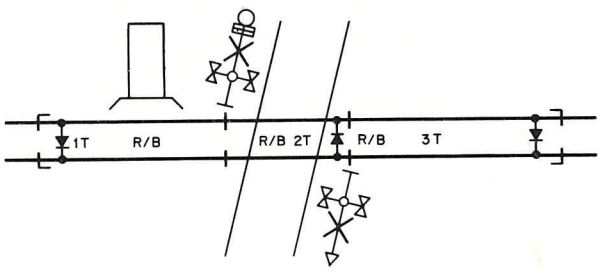
Power

Storage battery capacity is maintained by a 6-ampere automatic battery charger so that when the commercial power fails, the d-c and FSO track circuit systems and warning devices are completely supported by the standby battery until commercial power is restored. With a-c rectified (Type C) track circuits, the failure of commercial power results in an activation of the lights and bells, on a continuous basis, and gates are driven down where they remain until power is restored. In all installations, periodic maintenance of batteries and checks of power status are recommended.

Typical Arrangements

The typical arrangements of highway crossing warning equipment, shown below, use various track circuits for train detection and warning device control.

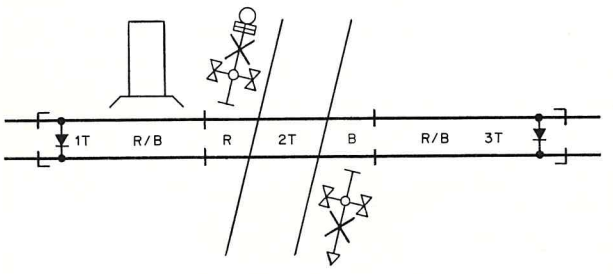
A-c Rectified (Type "C")



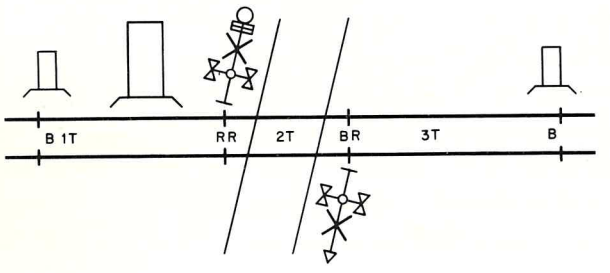
This arrangement, primarily for private and nonsignaled crossings, uses a-c rectified track circuits. All equipment, except a small wayside package at the start of each approach, is housed at the crossing. During commercial power failures, a 10-volt circuit is provided for automatic and continuous operation of the audible and visual devices, which serves as a notification that the failure has occurred.

A-c Rectified with D-c Island

This arrangement is similar to a-c rectified, as described above, except for a d-c island section.

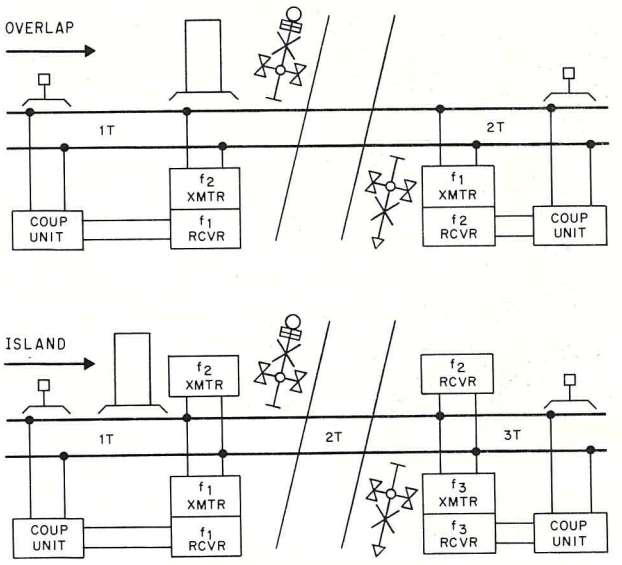


Direct Current

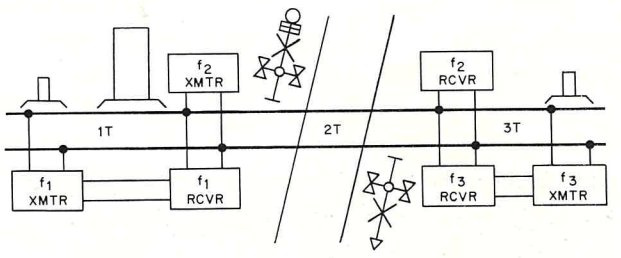


This arrangement, for railroads equipped with automatic block signals, uses d-c track circuits, which require additional insulated joints and rail bonding. All equipment, except track battery, is housed at the crossing.

Frequency Shift Overlay



These arrangements, for railroads equipped with automatic block signals, use FSO track circuits, which do not require insulated joints. All equipment, except a small coupling unit, is housed at the crossing.



The FSO transmitters can be housed in separate cases at the approaches to the crossing.

Signal Assemblies

A signal assembly consists of an aluminum mast, aluminum split junction box base, aluminum arms to support the flashing light signals, aluminum crossing signs, and optional Type D gate mechanism complete with arms, counterweights and hardware.

A four-inch diameter mast is provided when only flashing light signals are required; a five-inch diameter mast is provided when a gate mechanism is required.

Type XC flashing light signals have durable Lexan® roundels – 20° x 10° , 30° x 15° , and 70° x 0° spread and deflection roundel configurations are available.

Crossbuck and track signs are constructed of reflex – reflecting type sheeting permanently bonded to an aluminum base.

Type D gate mechanisms provide reliable, high speed operation with a minimum of maintenance. They are capable of handling gate arms up to 40 feet in length with a maximum clearing time of 10 seconds. Wood gate arms are available in lengths up to 38 feet; fiberglass arms, up to 32 feet. Each gate is supplied complete with the required brackets, grip arms, counterweights, spacers, and three lamps.

Type D Crossing Gate Mechanism

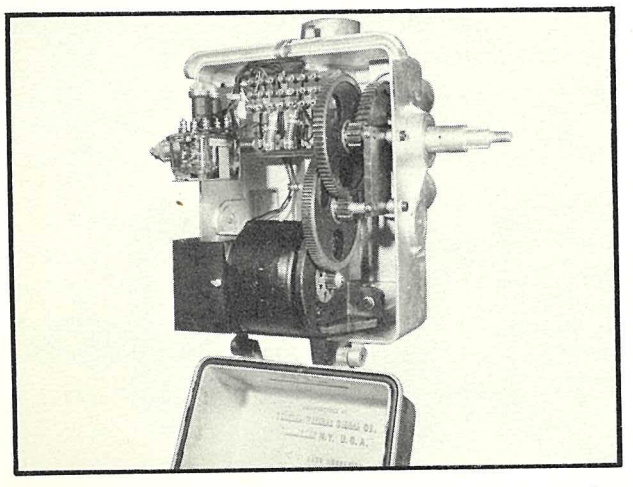
The GRS Type D automatic highway crossing gate mechanism provides reliable, highspeed operation with minimum maintenance. It is capable of handling gate arms up to 40 feet in length with a maximum clearing time of only 10 seconds.

Prelubricated, shielded or sealed bearings are used throughout the mechanism. The only lubrication required is the occasional application of grease to the gear teeth.

The mechanism is designed for low-voltage, d-c operation. The gate arm is raised from the horizontal to the clear position by means of a motor and gear train. Continuous protection is assured by a hold-clear magnet and associated locking device which holds the gate arm in the clear position as long as the supply energy is present. The approach of a train deenergizes the hold clear magnet and the gate arm descends by gravity.

To speed initial descent and to counter unusual conditions such as strong adverse wind, a combination of dynamic snub and power drive is utilized until the gate arm descends to a position 50 degrees from horizontal. From this position, the counterweighted gate arm descends by gravity. The rate of descent is retarded by dynamic snubbing.

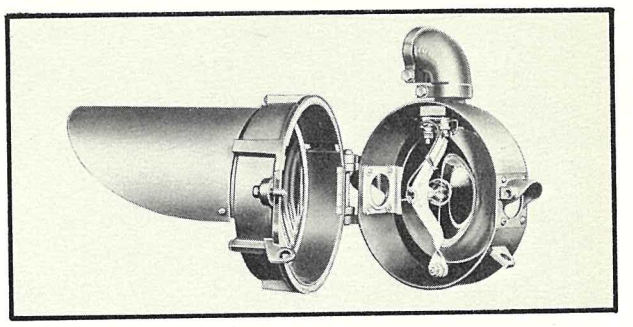
Available as options are a digital counter to record the number of gate operations, a heater, and a sidewalk arm conversion kit.



For more information, see GRS Pamphlet 1410.

Type XC Flashing Light Units

The flashing light units are designed so that it is easy to replace lamps, clean hardware, and aim the beams. Some features are:



Focusing—the socket is pre-adjusted to locate the lamp filament exactly on the optical center line at the reflector's focal point, thus ensuring maximum brilliance. If GRS precision filament lamps are used, lamps are easily changed without disturbing the focus.

Aiming — the clamp-type mounting elbow provides full vertical and horizontal adjustment to simplify aiming. It locks the lamp unit rigidly in place. GRS supplies complete aiming instructions.

Locking — the locking screw stays in the lug when the door is open — prevents loss. The conical point speeds threading the screw when closing the door; the slotted hex head is ideal for wrench or screwdriver. The 5/8-inch hasp hole accommodates a padlock.

Reflector — the parabolic mirror is backed with pure metallic silver for maximum brilliance and copperplate sealed for permanence. A felt washer and twin leaf springs protect the reflector against mechanical shock and rapid temperature changes.

Vent — the brass vent screen on the bottom of the door is tinned to prevent corrosion.

Roundels—precision roundels are available to shape the light beams in various degrees of horizontal spread and downward deflection.

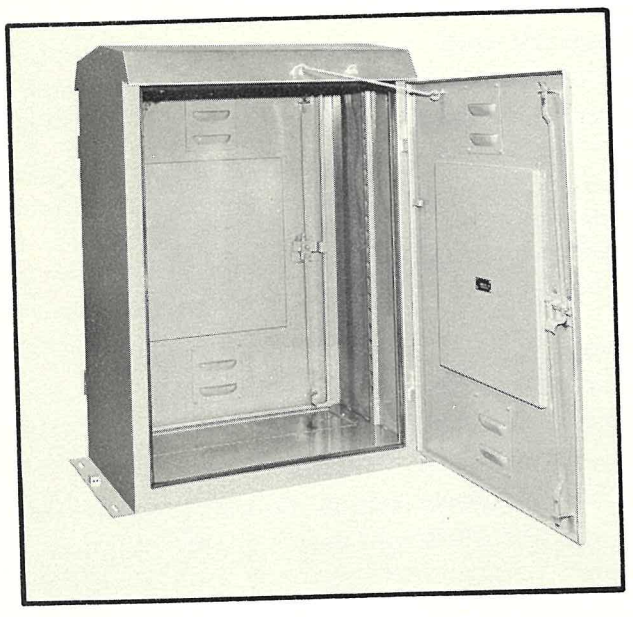
Case Wired Equipment

Building blocks for both pre-engineered and custom design highway crossing warning systems are directly from the GRS standard product line (listed below), thereby offering quality engineering, proven safety and reliability, and rugged parts built to AAR specifications.

	Assemblies Catalog Section
Cases, aluminum and steel	5
Relays, Type B, plug-in	62
Transformer, Type UT	95
Rectifiers, selenium	53
Capacitor Unit	18
Accessories	3

Equipment Cases

GRS equipment cases offer a great variety of adjustable fixtures to permit arranging equipment to fit the needs of a particular highway crossing. These cases are available in either maintenance free aluminum or corrosion resistant, welded steel.



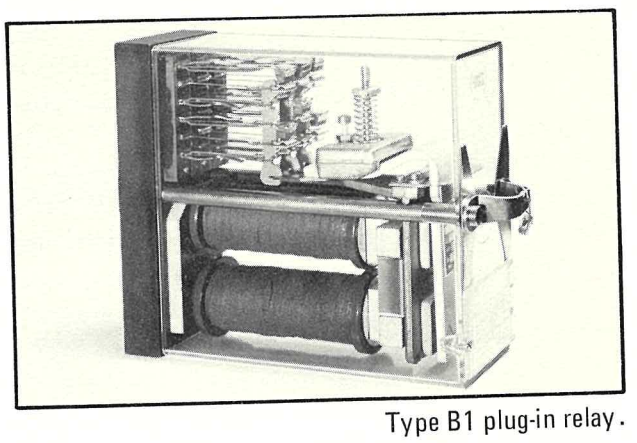
High single steel instrument case.

Permanently installed keyhole channels in the sides of the case provide for mounting shelves, backboards, and relay support bars for the best arrangement of the relays, batteries, transformers, rectifiers, etc.

For more information about GRS equipment cases, see GRS Assemblies Catalog, Section 5.

Plug-In Relays

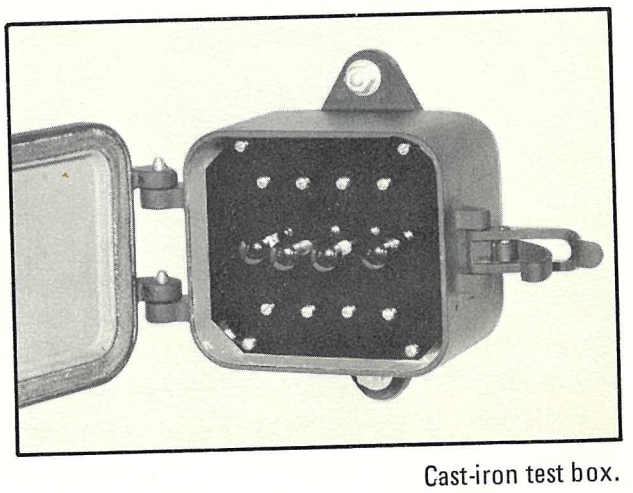
GRS Type B vital relays are designed for plug-in mounting on individual plugboards which are rack-installed in the equipment case. For more information, see GRS Catalog Section 62 and Pamphlet 1457.



Type B1 plug-in relay.

Test Box

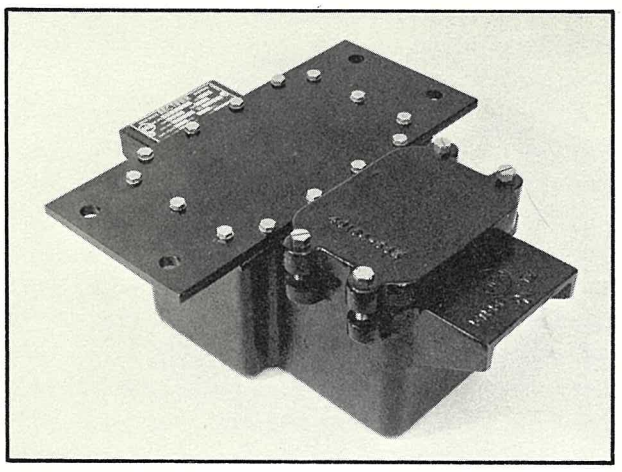
An optional test box is available for mounting on the equipment case or other convenient location. Switches, mounted in this weatherproof cast-iron box, provide an easy way of checking the operation of the crossing warning devices.



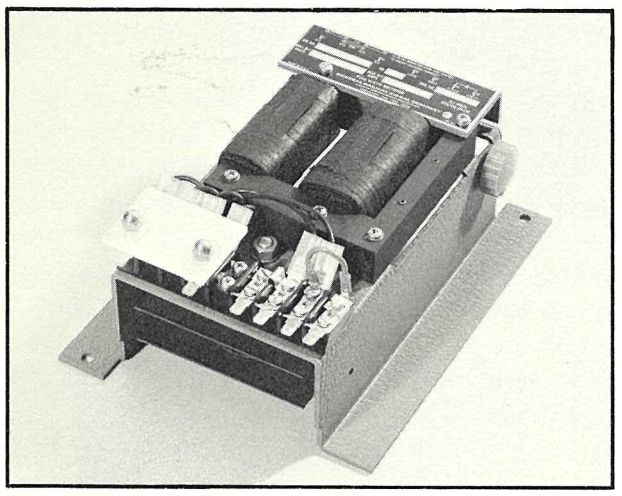
Cast-iron test box.

Rectifiers

Type SVA selenium rectifiers are used with a-c rectified track circuits. One rectifier is located at the far end of each approach circuit and one in the island circuit, thus eliminating the need for batteries, line drops, and battery boxes at these points.



Type SVA track rectifier.



Type ST selenium rectifier.

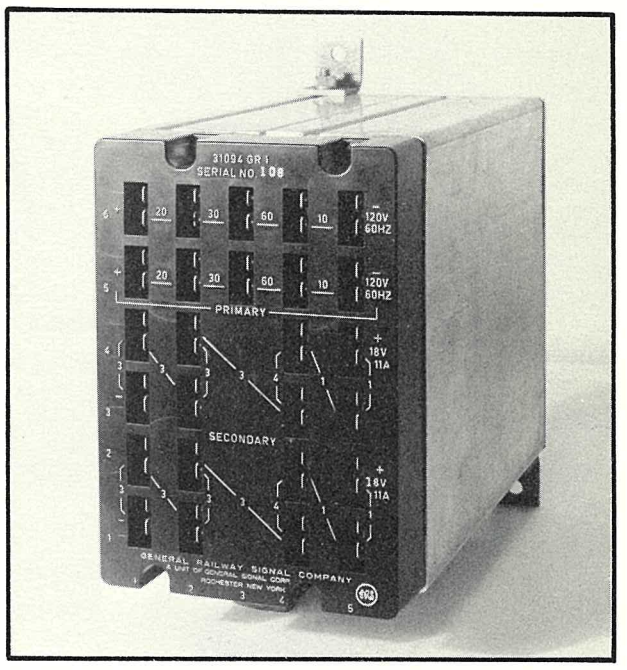
A GRS Type ST selenium rectifier is used for charging the standby batteries. It operates at uniform high efficiency over wide load variations, requires little maintenance, and takes up very little space. The rectifier has an adjustable, reactive transformer which provides, by means of a micrometer screw adjustment of the laminated yoke, an easy and gradual adjustment of the charging current.

For more information about GRS rectifiers, see GRS Assemblies Catalog, Section 53.

Transformer

The GRS Type UT transformer is engineered to provide years of trouble-free service, complete reliability, and a minimum of maintenance. It is designed expressly for use in railway signaling circuits.

The Type UT is an air-cooled transformer which has high insulation strength and provides good regulation with low core loss. It is wound to Association of American Railroad Signal Section Specifications. For more information, see GRS Catalog 95-1.



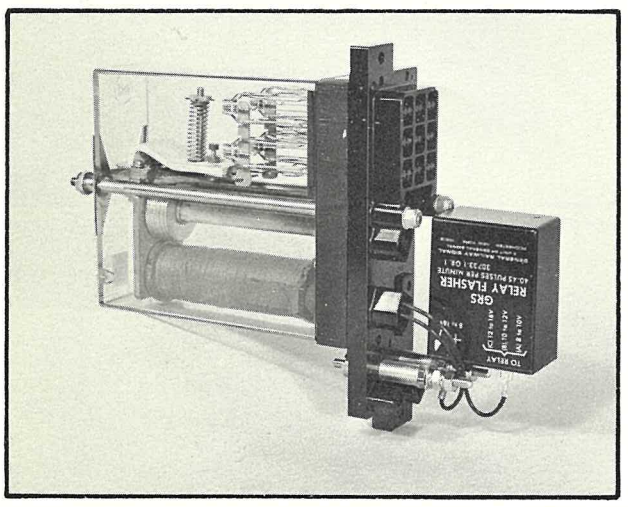
Type UT air-cooled transformer.

Flasher Module

The electronic flasher module mounts on the back of the Type B relay plugboard. The module uses the latest component technology which provides a high level of reliability and enables it to withstand surges of at least 1500 volts d-c.

The module, enclosed in a high impact-resistant polycarbonate case and cover, drives its associated neutral relay at a constant flashing rate (40 to 45 flashes per minute) through a voltage range of 6 to 16 volts d-c. The flashing rate is determined solely by the circuit constants of the module and is not affected by the relay – there is nothing to adjust.

Two input terminals provide the means of mechanically mounting and electrically coupling the module to the relay. The relay has a single operating coil for rapid pickup, and four dependent, front-back, heavy-duty, nonfusing lamp control contacts. Equal front and back contact pressure is maintained while the relay is operating; full back contact pressure is maintained while the relay is not operating.



Type B1 flasher relay .

Approach FSO

GRS approach Frequency Shift Overlay (FSO) track circuits provide high noise immunity train detection for highway crossing protection, without using insulated joints, on single or multiple track with single or double-direction traffic. Approach FSO track circuits can be up to 6000 feet long.

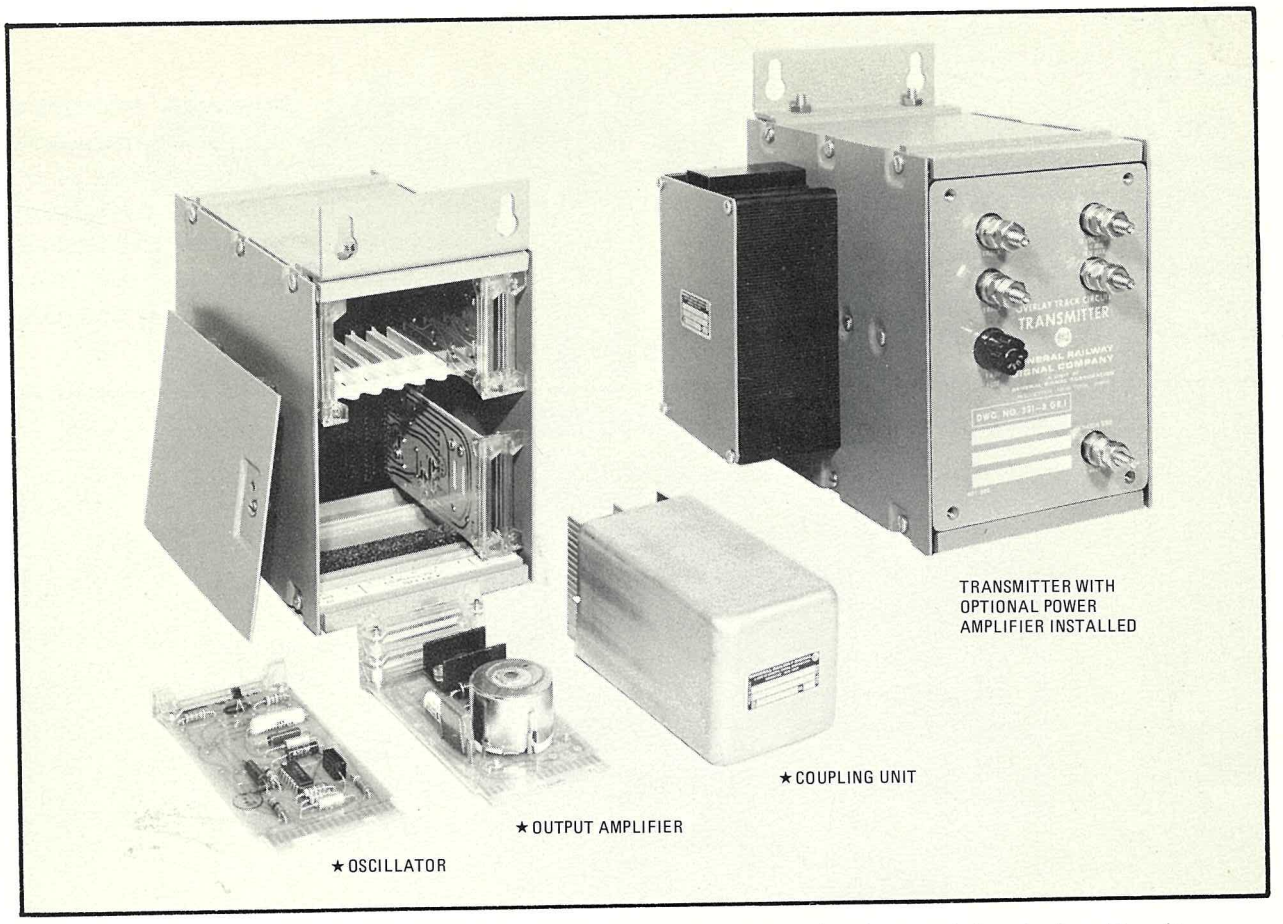
FSO equipment is available for 15 mutually compatible operating frequency channels. These frequencies reduce the possibility of interference from harmonics of power line frequencies, or from the combined effects of power line harmonics and other FSO equipment. Even numbered channels are shifted at a rate of 13 Hz; odd numbered channels at 15 Hz.

The FSO equipment for a basic track circuit consists of a transmitter, receiver, and biased-neutral track relay. Options include: a capacitor kit and a power amplifier for use under unusual noise conditions, facilities for centralized operation over line wires, and an insulated joint bypass unit.

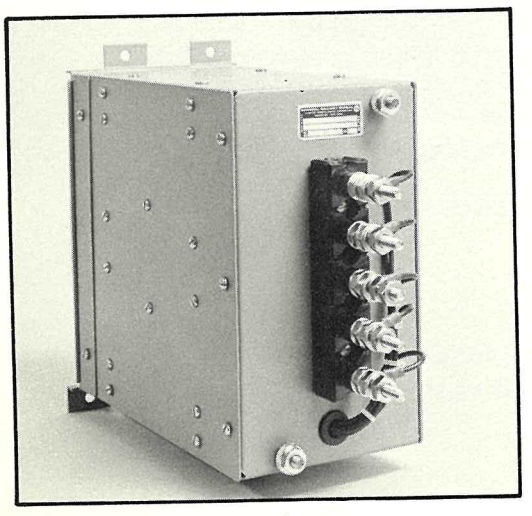
The optional insulated joint bypass unit effectively passes approach FSO frequencies around insulated joints, with a small reduction (typically 20%) in track circuit length. The unit can operate in areas with a minimum track ballast resistance as low as 2 ohms in 1000 feet, and a temperature range of -40° F to +160° F (-40° C to +71° C). It has a minimum attenuation of 20 db at 100 Hz. The unit can be rack mounted or wall mounted.

The weatherproof remote coupling case comes wired complete with lightning and surge protection equipment.

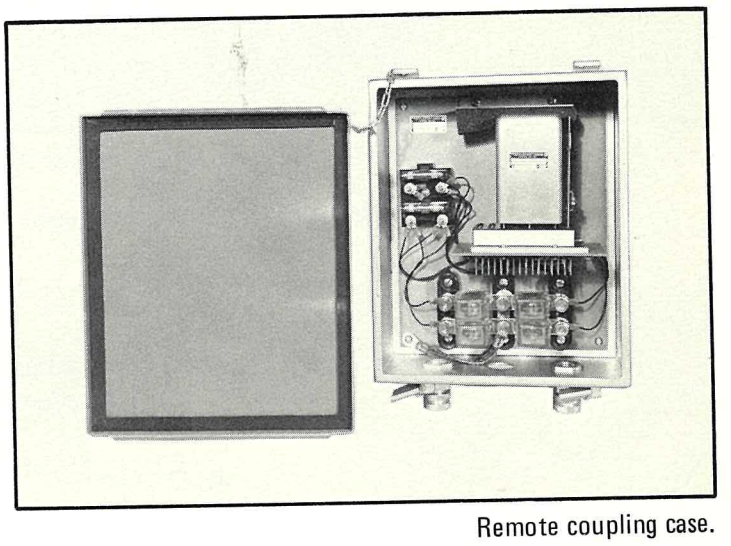
For more information about approach FSO, see GRS Catalog 92-2 and GRS Pamphlet 1416.



Approach FSO transmitter, with cover removed to show plug-in, modular design. To alter frequency, only the three starred items are changed. The power amplifier, an option, is shown on the right attached to a transmitter.



Insulated joint bypass unit.



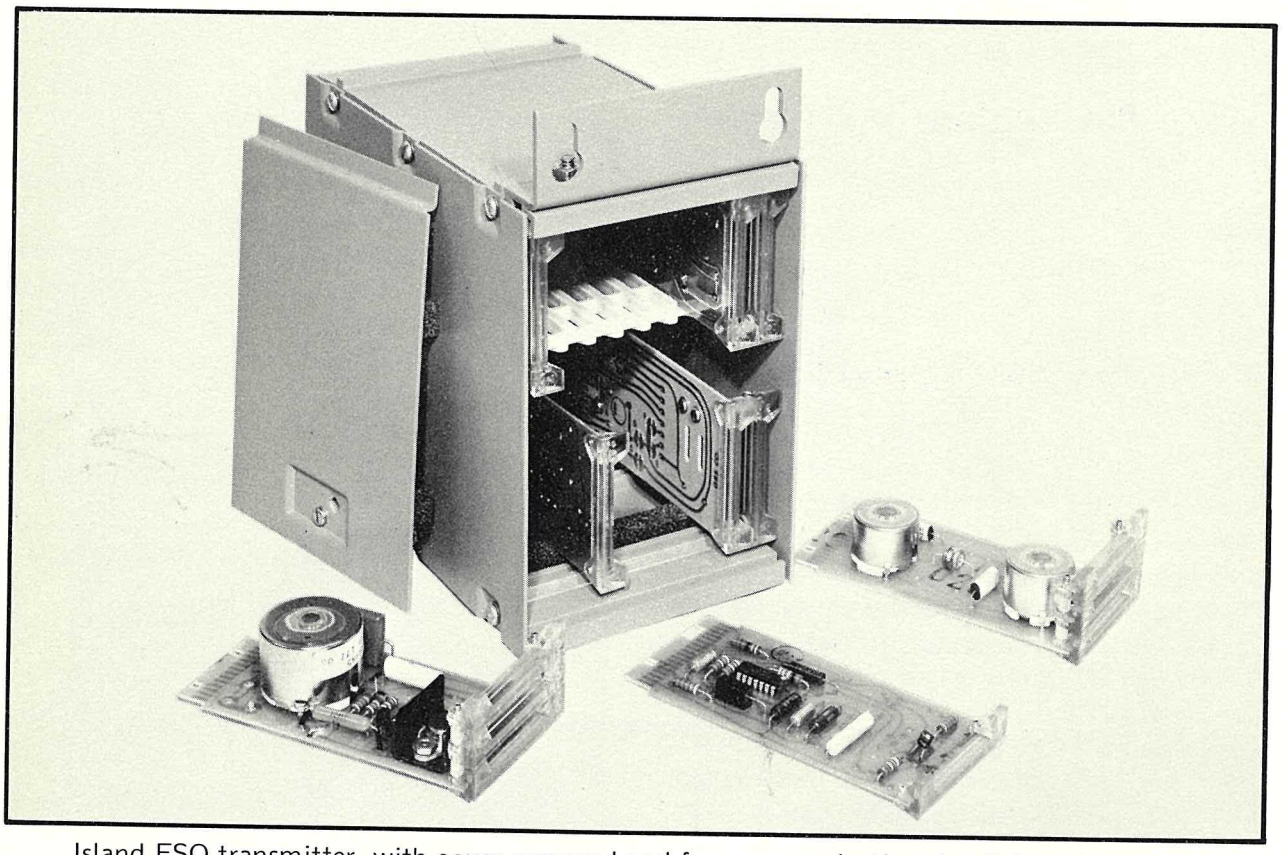
Remote coupling case.

Island FSO

GRS island Frequency Shift Overlay (FSO) track circuit equipment is similar to that used for GRS approach frequency shift overlay (FSO) track circuits, except that it is available in three higher frequencies. These frequencies, ideal for short track circuits, provide high shunting sensitivity.

The three mutually compatible frequencies are also compatible with the fifteen frequencies available with approach FSO equipment.

The equipment for an island FSO track circuit consists of a solid-state transmitter and receiver, and a biased neutral track relay. For more information, see GRS Catalog 92-2 and GRS Pamphlet 1503.



Island FSO transmitter, with cover removed and frequency selective circuit boards removed.

ordering information

Pre-engineered System

To order a pre-engineered system, please complete a copy of the "ORDER FORM" provided on page 29 and send it to your GRS sales engineer. Completion of this form will enable prompt delivery of your system. If the order form for the pre-engineered system does not describe your highway crossing requirements, refer to "Custom Designed System" which follows.

Custom Designed System

Highway crossing warning systems must be based on approved principles of operation, but they are subject to a wide range of variations. It is often necessary to design the control circuits to fit special operating situations — switching moves, time-out circuits, highway traffic variables, etc.

When your requirements exceed or differ from the pre-engineered systems that GRS has available for prompt delivery and, therefore, require application engineering, complete a copy of the "Design Questionnaire" provided on page 31 and send it to your GRS sales engineer. Upon receipt of the completed questionnaire, GRS will start work immediately on your highway crossing system. If you require assistance in completing this questionnaire, see your GRS sales engineer.

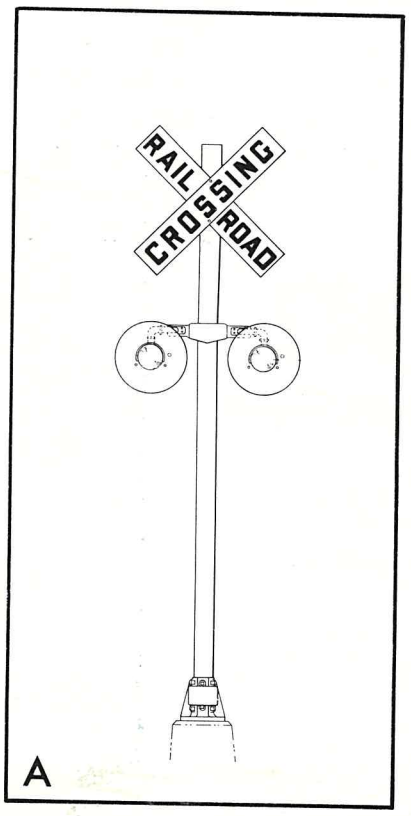
Signal Assemblies

For ordering information pertaining to signal assemblies, see pages 14 through 24.

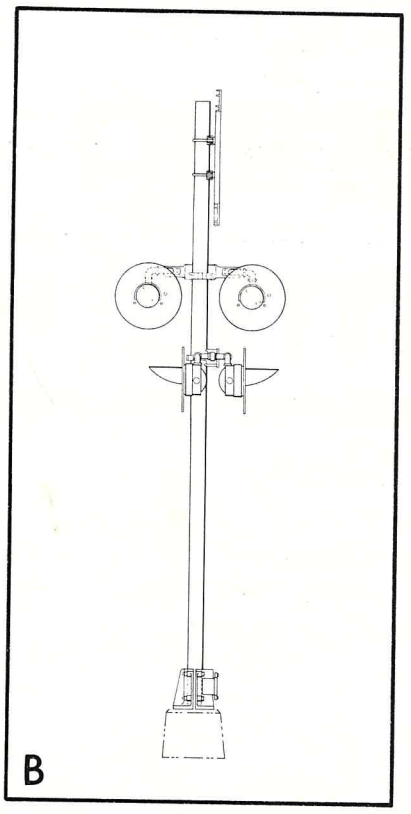
Cases

For ordering information pertaining to unwired and prewired equipment cases, see pages 25 through 28.

Ordering Information for Signal Assemblies



A



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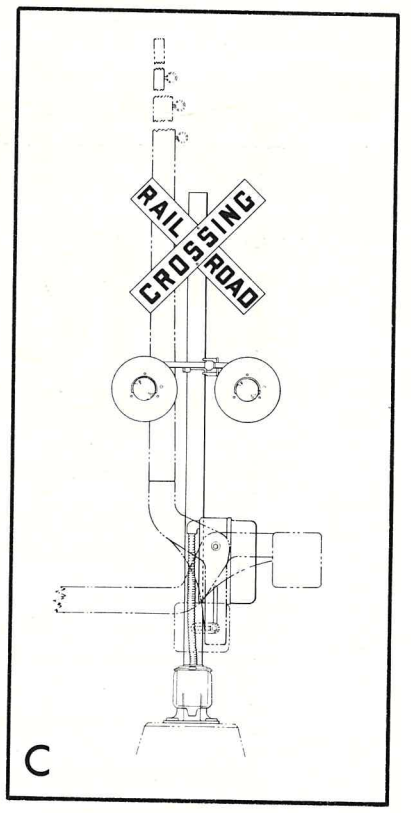

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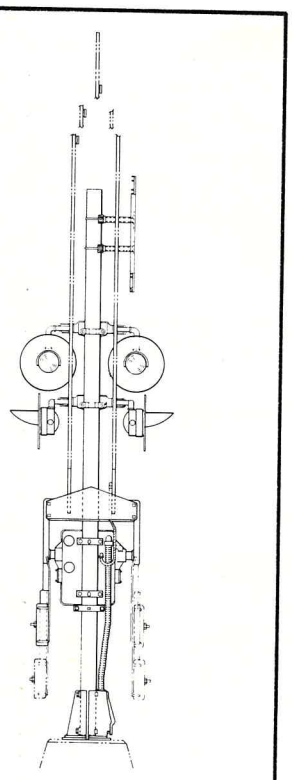

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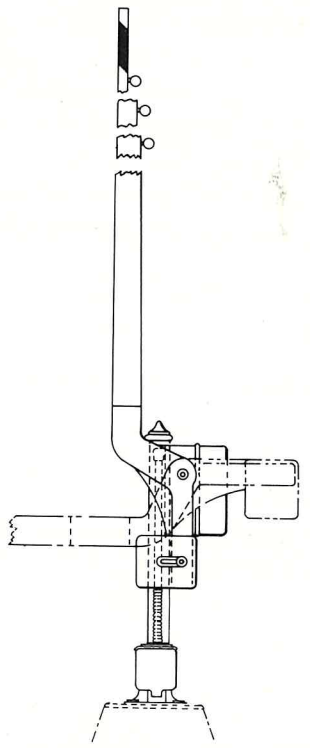


E

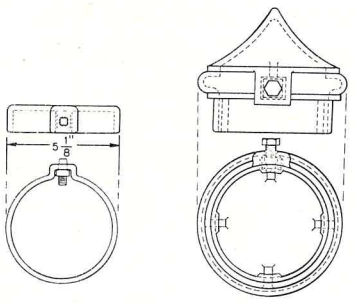
PLEASE ORDER BY CATALOG NUMBER AND NAME SHOWN IN BOLD TYPE

Signal assemblies are furnished with caps. If bells are required instead of caps, please specify. Order lamp bulbs separately – see GRS Assemblies Catalog Section 46. For assemblies with gate mechanisms, order gate arms separately; see page 22 for order number or simply specify desired length and either wood or fiberglass.

REFERENCE NUMBER	NAME	CATALOG NUMBER
A	**BASIC SIGNAL ASSEMBLY,** 4" dia. X 13' high aluminum pipe, crossing sign, crossarm with four Type XC flashing light units with 30° X 15° roundels, and junction box base	A30-500
A1	**BASIC SIGNAL ASSEMBLY,** same as A except crossarm with two flashing light units	A30-501
B	**BASIC SIGNAL ASSEMBLY,** 4" dia. X 15' high aluminum pipe, crossing sign, two crossarms each with four Type XC flashing light units with 30° X 15° roundels, and junction box base	A30-502
B1	**BASIC SIGNAL ASSEMBLY,** same as B except upper crossarm with two flashing light units	A30-503
C	**BASIC SIGNAL ASSEMBLY,** for crossing gate, 5" dia. X 13' high aluminum pipe, crossing sign, crossarm with four Type XC flashing light units with 30° X 15° roundels, junction box base, and Type D gate mechanism	A30-504
C1	**BASIC SIGNAL ASSEMBLY ,** same as C except crossarm with two flashing light units	A30-505
C2	**BASIC SIGNAL ASSEMBLY,** same as C except without gate mechanism .	A30-506
C3	**BASIC SIGNAL ASSEMBLY,** same as C except crossarm with two flashing light units and without gate mechanism	A30-507
D	**BASIC SIGNAL ASSEMBLY,** for crossing gate, 5" dia. X 16' high aluminum pipe, crossing sign, two crossarms, each with four Type XC flashing light units with 30° X 15° roundels, junction box base, and Type D gate mechanism	A30-508
D1	**BASIC SIGNAL ASSEMBLY,** same as D except upper crossarm with two flashing light units	A30-509
D2	**BASIC SIGNAL ASSEMBLY,** same as D except without gate mechanism .	A30-510
D3	**BASIC SIGNAL ASSEMBLY,** same as D except upper crossarm with two flashing light units and without gate mechanism	A30-511
E	**CROSSING GATE ONLY ASSEMBLY,** 5" dia. X 6' high aluminum pipe, pinnacle, Type D gate mechanism, and junction box base	A30-512

Ordering Information for Optional Equipment and Replacement Parts

1



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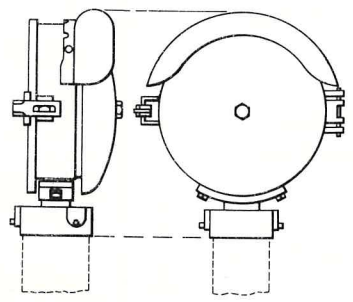

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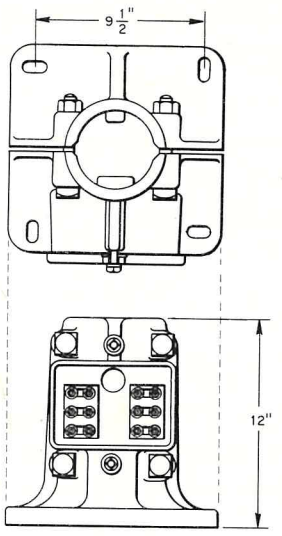
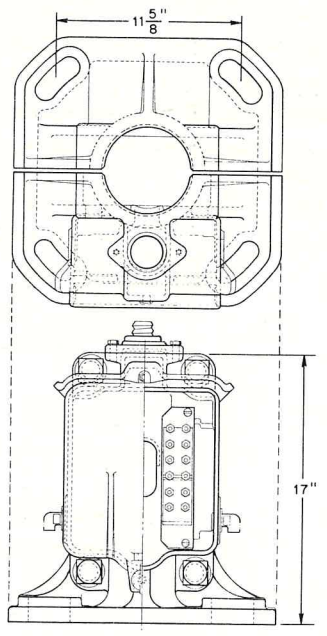
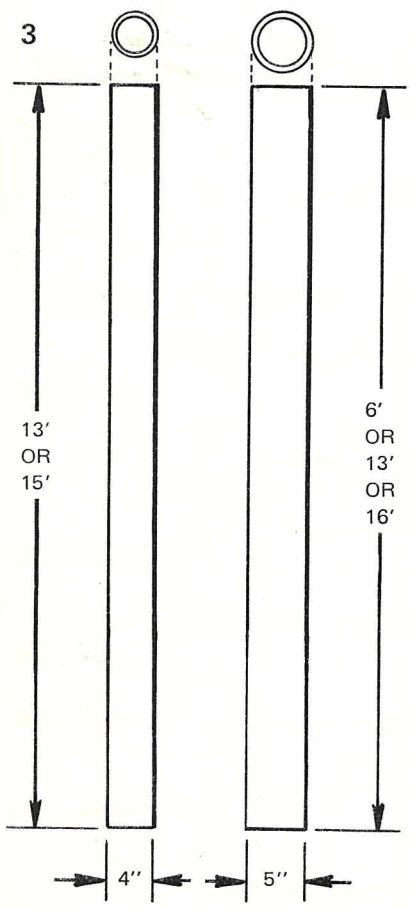


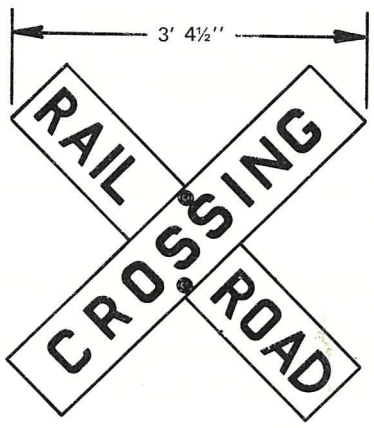
For 4" dia pipe



For 5" dia pipe

3

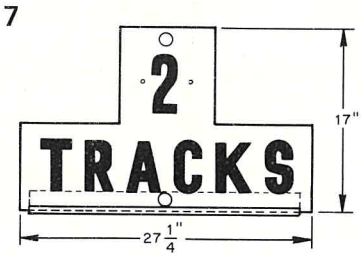




5

6

7



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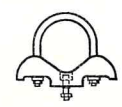
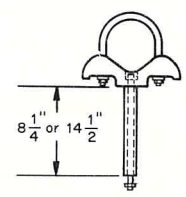


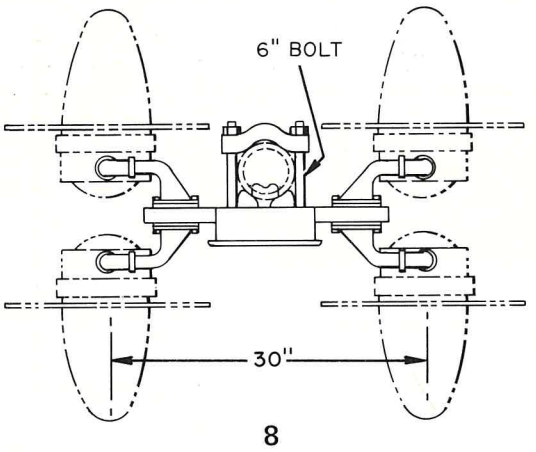
Hardware for mounting signs on 4" dia pipe (2 included)



Hardware for mounting signs on 5" dia pipe (2 included)

PLEASE ORDER BY CATALOG NUMBER AND NAME SHOWN IN BOLD TYPE

REFERENCE NUMBER	NAME	CATALOG NUMBER 4" DIA. PIPE	CATALOG NUMBER 5" DIA. PIPE
1	**FLAT CAP**	A30-520	——
1a	**PINNACLE CAP**	——	A30-521
2	**BELL**	A30-522	A30-523
3	**ALUMINUM PIPE,** 13' high, predrilled with all necessary holes	A30-528	A30-529
3a	**ALUMINUM PIPE,** 15' high, predrilled with all necessary holes	A30-530	——
3b	**ALUMINUM PIPE,** 16' high, predrilled with all necessary holes	——	A30-531
3c	**ALUMINUM PIPE,** 6' high, predrilled with all necessary holes	——	A30-533
4	**JUNCTION BOX BASE**	A30-536	A30-537
4a	**DOUBLE JUNCTION BOX BASE**	A30-538	A30-539
4b	**HALF BASE**	A30-540	A30-541
4c	**HALF BASE WITH JUNCTION BOX**	A30-542	A30-543
4d	**COVER,** for junction box	A30-544	A30-545
4e	**CONDUIT**	——	A30-547
4f	**COUPLING**	——	A30-549
4g	**BOLTS and NUTS**	A30-550	A30-551
5	**RAILROAD CROSSING SIGN,** includes all mounting hardware	A30-552	A30-553
6	**RAILWAY CROSSING SIGN,** includes all mounting hardware	A30-554	A30-555
7	**TRACK SIGN,** 2 tracks, includes all mounting hardware	A30-558	A30-559
7a	**TRACK SIGN,** 3 tracks	A30-560	A30-561
7b	**TRACK SIGN,** 4 tracks	A30-562	A30-563
7c	**TRACK SIGN,** 5 tracks	A30-564	A30-565
7d	**TRACK SIGN,** 6 tracks	A30-566	A30-567



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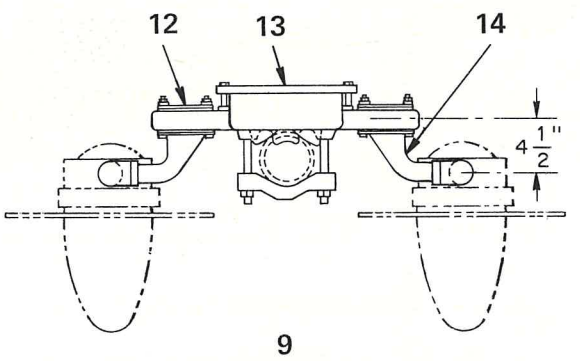

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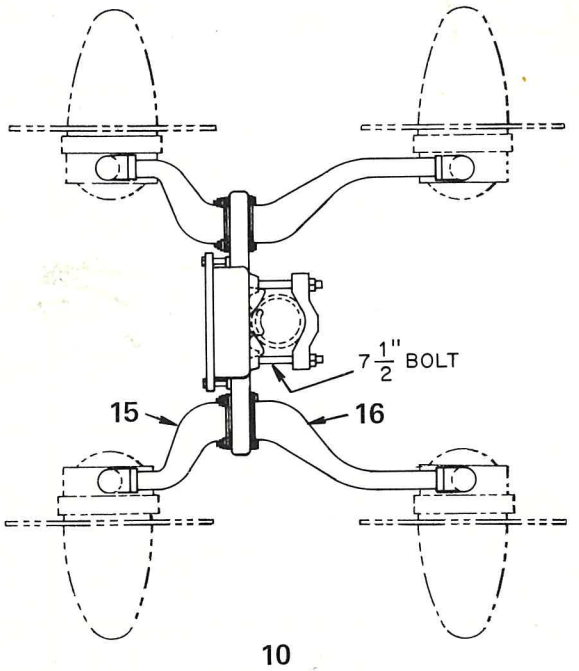

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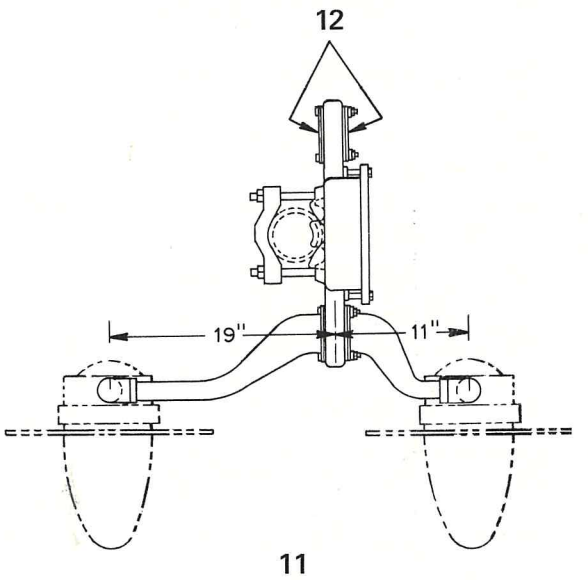

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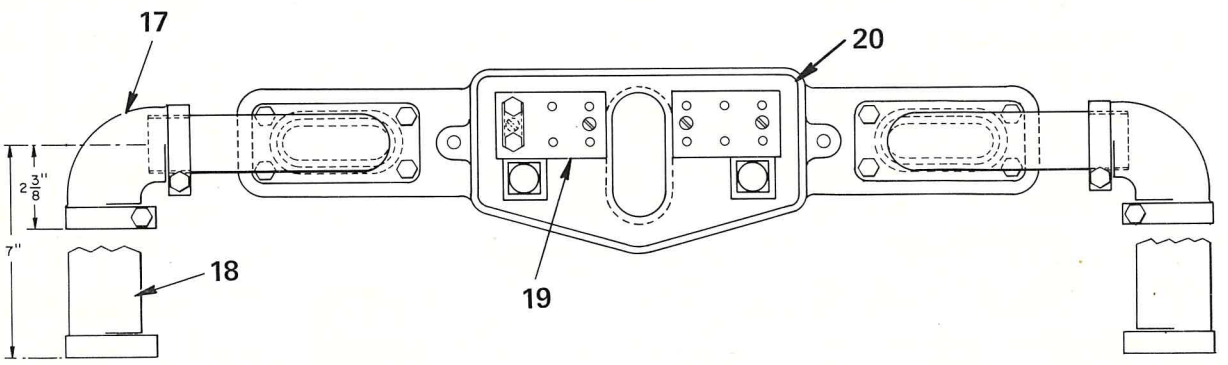
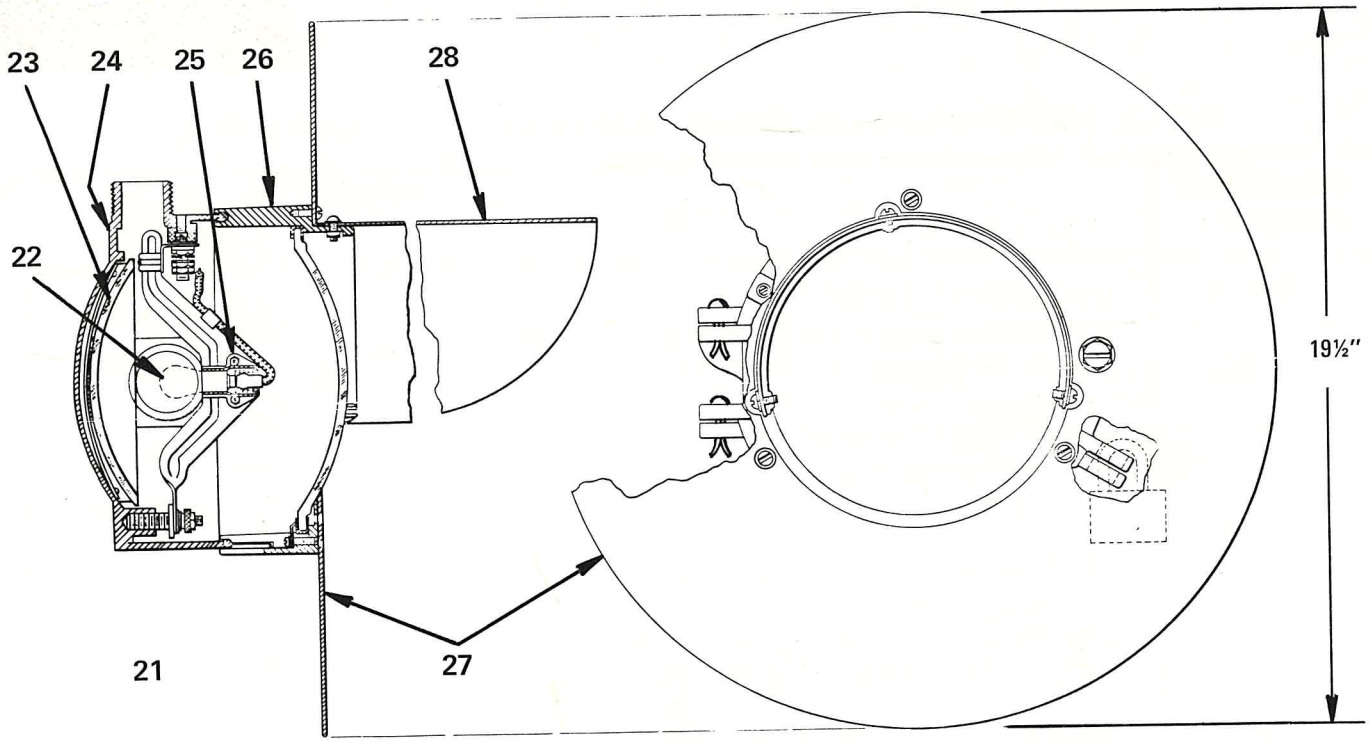


PLEASE ORDER BY CATALOG NUMBER AND NAME SHOWN IN BOLD TYPE

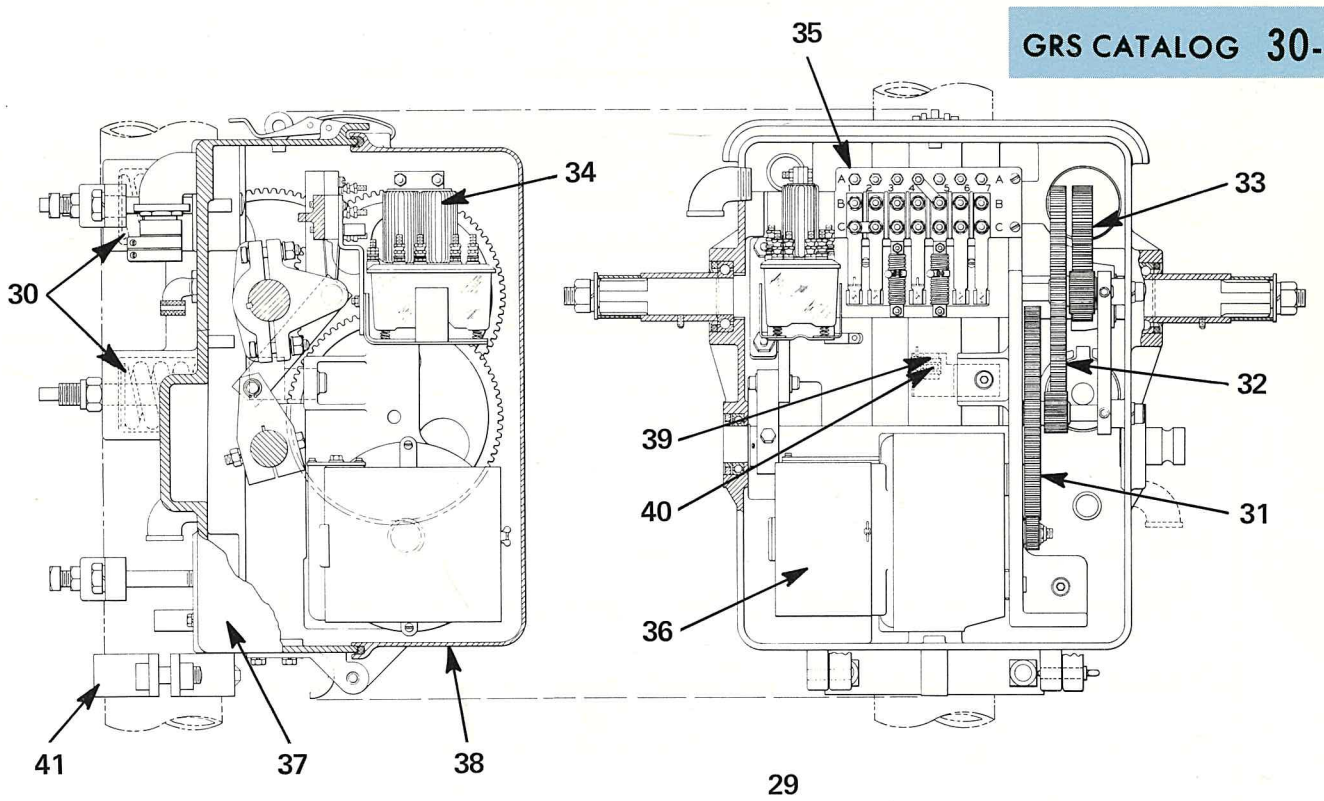
REFERENCE NUMBER	NAME	CATALOG NUMBER
8 *	**CROSSARM ASSEMBLY,** for four Type XC flashing light units, crossarm with junction box, brackets, elbows, clamp and bolts for mounting on 4" dia. pipe	A30-575
9 *	**CROSSARM ASSEMBLY,** same as 8 except crossarm for only two flashing light units and includes two cover plates (ref. 12)	A30-578
10 *	**CROSSARM ASSEMBLY,** for signal assembly with crossing gate, for four Type XC flashing light units, crossarm with junction box, brackets, elbows, clamp and bolts for mounting on 5" dia. pipe	A30-581
10a *	**CROSSARM ASSEMBLY,** same as 10 except crossarm for four flashing light units on upper arm	A30-582
11 *	**CROSSARM ASSEMBLY,** same as 10 except crossarm for only two flashing light units and includes two cover plates (ref. 12)	A30-584
11a *	**CROSSARM ASSEMBLY,** same as 10 except crossarm for two flashing light units on upper arm and includes two cover plates (ref. 12)	A30-585
12	**COVER PLATE,** for crossarm bracket opening	A30-587
13	**COVER,** for crossarm junction box	A30-588
14	**BRACKET,** for mounting flashing light unit to crossarm on 4" dia. pipe	A30-589
15	**BRACKET,** 8 1/2" long, for mounting flashing light unit to crossarm used on 5" dia. pipe with crossing gate	A30-590
16	**BRACKET,** same as 15 except 16 1/2" long	A30-591
17	**ELBOW,** 2 3/8" long, for attaching flashing light unit to bracket on crossarm	A30-592
18	**ELBOW,** same as 17 except 7" long	A30-593
19	**TERMINAL BLOCK,** for crossarm junction box	A30-594
20	**CROSSARM ONLY**	A30-595

* *Type XC flashing light units are not included with crossarm assemblies. See next page to order light units.*



PLEASE ORDER BY CATALOG NUMBER AND NAME SHOWN IN BOLD TYPE

REFERENCE NUMBER	NAME	CATALOG NUMBER
21	**TYPE XC FLASHING LIGHT UNIT COMPLETE,** with hood, background, and 30° X 15° roundel with hot spot	A30-600
21a	**TYPE XC FLASHING LIGHT UNIT,** same as 21 except with 20° X 10° roundel with hot spot	A30-601
21b	**TYPE XC FLASHING LIGHT UNIT,** same as 21 except with 70° spread - no deflection roundel with hot spot	A30-602
22	**LAMP BULB,** 10 volts, 18 watts (for other lamp bulbs, see catalog section 46)	A46-105
23	**REFLECTOR**	A30-605
24	**CASE ONLY**	A30-606
25	**RECEPTACLE,** for lamp bulb	A30-607
26	**FRONT RING,** for case	A30-608
27	**BACKGROUND**	A30-609
28	**HOOD**	A30-610



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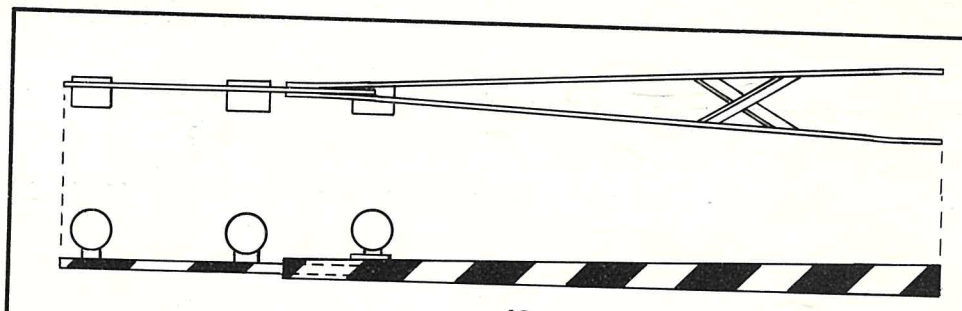
PLEASE ORDER BY CATALOG NUMBER AND NAME SHOWN IN BOLD TYPE

REFERENCE NUMBER	NAME	CATALOG NUMBER
29	TYPE D GATE MECHANISM COMPLETE	A30-615
30	SPRING STOP ASSEMBLY, upper and lower	A30-616
31	FIRST INTERMEDIATE GEAR COMPLETE	A30-617
32	SECOND INTERMEDIATE GEAR COMPLETE	A30-618
33	SECTOR	A30-619
34	RELAY	A65-345
35	CONTACT BLOCK COMPLETE	A30-620
36	MOTOR	A30-621
37	CASE ONLY	A30-622
38	COVER, for case	A30-623
39	HEATER COMPLETE	A30-624
40	COUNTER COMPLETE	A30-625
41	CLAMP	A30-626



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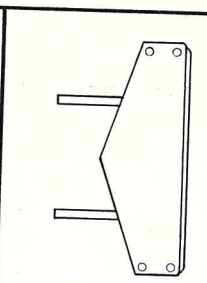

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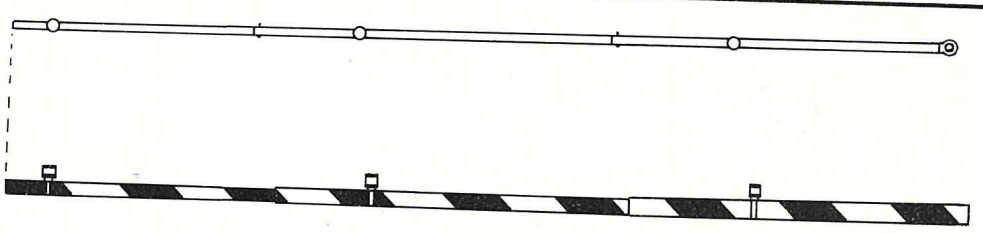

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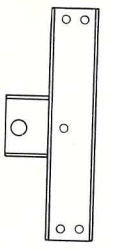

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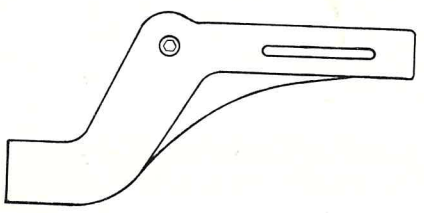

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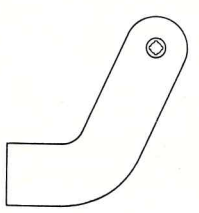

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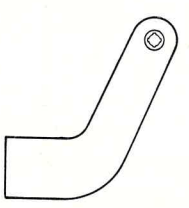

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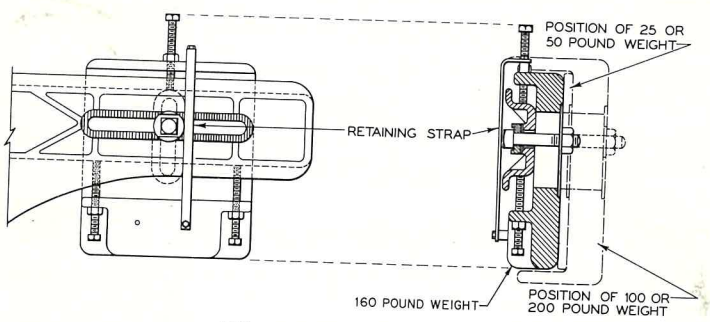

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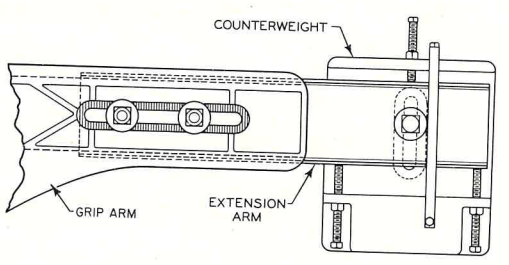

51

PLEASE ORDER BY CATALOG NUMBER AND NAME SHOWN IN BOLD TYPE

REFERENCE NUMBER	NAME	CATALOG NUMBER
42	**WOODEN GATE ARM,** with red and white stripes of reflex-reflecting sheet material, complete with lights, adjustable from 16′ to 22′ long	**A30-630**
42a	**WOODEN GATE ARM,** same as 42 except adjustable from 24′ to 30′ long	**A30-631**
42b	**WOODEN GATE ARM,** same as 42 except adjustable from 32′ to 38′ long	**A30-632**

PLEASE ORDER BY CATALOG NUMBER AND NAME SHOWN IN BOLD TYPE

REFERENCE NUMBER	NAME	CATALOG NUMBER
43	**FIBERGLASS GATE ARM,** with red and white stripes of reflex-reflecting sheet material, complete with lights, 14' long	A30-635
43a	**FIBERGLASS GATE ARM,** same as 43 except 16' long	A30-636
43b	**FIBERGLASS GATE ARM,** same as 43 except 18' long	A30-637
43c	**FIBERGLASS GATE ARM,** same as 43 except 20' long	A30-638
43d	**FIBERGLASS GATE ARM,** same as 43 except 22' long	A30-639
43e	**FIBERGLASS GATE ARM,** same as 43 except 24' long	A30-640
43f	**FIBERGLASS GATE ARM,** same as 43 except 26' long	A30-641
43g	**FIBERGLASS GATE ARM,** same as 43 except 28' long	A30-642
43h	**FIBERGLASS GATE ARM,** same as 43 except 30' long	A30-643
43i	**FIBERGLASS GATE ARM,** same as 43 except 32' long	A30-644
44	**BRACKET,** with hardware, for attaching wooden gate arm to counterweight arms	A30-650
45	**BRACKET,** with hardware, for attaching fiberglass gate arm to counterweight arms	A30-651
46	**ARM,** counterweight, left-hand	A30-654
46a	**ARM,** same as 46 except right-hand	A30-655
47	**ARM,** gate support, left-hand only	A30-656
48	**ARM,** sidewalk arm support	A30-657
49	**CONVERSION KIT,** all parts necessary to convert Type D gate mechanism for use with a sidewalk arm	A30-660
50	**COUNTERWEIGHT,** 25 pounds	A30-663
50a	**COUNTERWEIGHT,** 50 pounds	A30-664
50b	**COUNTERWEIGHT COMPLETE,** 100 pounds	A30-665
50c	**COUNTERWEIGHT COMPLETE,** 160 pounds	A30-666
50d	**COUNTERWEIGHT COMPLETE,** 200 pounds	A30-667

PLEASE ORDER BY CATALOG NUMBER AND NAME SHOWN IN BOLD TYPE

REFERENCE NUMBER	NAME	CATALOG NUMBER
51	**EXTENSION ARM,** for counterweights	**A30-669**
52	**MOUNTING KIT,** for 14' long fiberglass gate, complete with all counterweights, arms, and field hardware	**A30-670**
52a	**MOUNTING KIT,** same as 52 except for a 16' long fiberglass gate	**A30-671**
52b	**MOUNTING KIT,** same as 52 except for a 18' long fiberglass gate	**A30-672**
52c	**MOUNTING KIT,** same as 52 except for a 20' long fiberglass gate	**A30-673**
52d	**MOUNTING KIT,** same as 52 except for a 22' long fiberglass gate	**A30-674**
52e	**MOUNTING KIT,** same as 52 except for a 24' long fiberglass gate	**A30-675**
52f	**MOUNTING KIT,** same as 52 except for a 26' long fiberglass gate	**A30-676**
52g	**MOUNTING KIT,** same as 52 except for a 28' long fiberglass gate	**A30-677**
52h	**MOUNTING KIT,** same as 52 except for a 30' long fiberglass gate	**A30-678**
52i	**MOUNTING KIT,** same as 52 except for a 32' long fiberglass gate	**A30-679**
53	**MOUNTING KIT,** for a 16' to 22' adjustable wooden gate, complete with all counterweights, arms, and field hardware	**A30-683**
53a	**MOUNTING KIT,** same as 53 except for a 24' to 30' adjustable wooden gate	**A30-684**
53b	**MOUNTING KIT,** same as 53 except for a 32' to 38' adjustable wooden gate	**A30-685**

Ordering Information for Pre-Engineered Cases *

A. STEEL CASES FOR FLASHING LIGHTS ONLY		CATALOG NUMBER SINGLE TRACK	CATALOG NUMBER DOUBLE TRACK
1. A-c rectified with island	wired	A30-701	A30-702
	unwired	A30-703	A30-704
2. A-c rectified with d-c island	wired	A30-705	A30-706
	unwired	A30-707	A30-708
3. D-c with island	wired main	A30-709	A30-710
	unwired main	A30-711	A30-712
	wired approach	A30-713	A30-714
	unwired approach	A30-715	A30-716
4. FSO with overlap (Includes remote coupling case A92-750)	wired	A30-717	A30-718
	unwired	A30-719	A30-720
5. FSO with island (Includes remote coupling case A92-750)	wired	A30-721	A30-722
	unwired	A30-723	A30-724
6. Same as 4 except transmitters are located in separate cases at approaches	wired main	A30-725	A30-726
	unwired main	A30-727	A30-728
	wired approach	A30-729	A30-730
	unwired approach	A30-731	A30-732
7. Same as 5 except transmitters are located in separate cases at approaches	wired main	A30-733	A30-734
	unwired main	A30-735	A30-736
	wired approach	A30-737	A30-738
	unwired approach	A30-739	A30-740

* *When ordering pre-engineered cases, please specify type of battery charger required for each main case—either nickel cadmium A30-900 or lead acid A30-901.*

B. STEEL CASES FOR FLASHING LIGHT AND CROSSING GATES		CATALOG NUMBER SINGLE TRACK	CATALOG NUMBER DOUBLE TRACK
1. A-c rectified with island	wired unwired	A30-751 A30-753	A30-752 A30-754
2. A-c rectified with d-c island	wired unwired	A30-755 A30-757	A30-756 A30-758
3. D-c with island	wired main unwired main wired approach unwired approach	A30-759 A30-761 A30-763 A30-765	A30-760 A30-762 A30-764 A30-766
4. FSO with overlap (Includes remote coupling case A92-750)	wired unwired	A30-767 A30-769	A30-768 A30-770
5. FSO with island (Includes remote coupling case A92-750)	wired unwired	A30-771 A30-773	A30-772 A30-774
6. Same as 4 except transmitters are located in separate cases at approaches	wired main unwired main wired approach unwired approach	A30-775 A30-777 A30-779 A30-781	A30-776 A30-778 A30-780 A30-782
7. Same as 5 except transmitters are located in separate cases at approaches	wired main unwired main wired approach unwired approach	A30-783 A30-785 A30-787 A30-789	A30-784 A30-786 A30-788 A30-790

C. ALUMINUM CASES FOR FLASHING LIGHTS ONLY		CATALOG NUMBER SINGLE TRACK	CATALOG NUMBER DOUBLE TRACK
1. A-c rectified with island	wired unwired	A30-801 A30-803	A30-802 A30-804
2. A-c rectified with d-c island	wired unwired	A30-805 A30-807	A30-806 A30-808
3. D-c with island	wired main unwired main wired approach unwired approach	A30-809 A30-811 A30-813 A30-815	A30-810 A30-812 A30-814 A30-816
4. FSO with overlap (Includes remote coupling case A92-750)	wired unwired	A30-817 A30-819	A30-818 A30-820
5. FSO with island (Includes remote coupling case A92-750)	wired unwired	A30-821 A30-823	A30-822 A30-824
6. Same as 4 except transmitters are located in separate cases at approaches	wired main unwired main wired approach unwired approach	A30-825 A30-827 A30-829 A30-831	A30-826 A30-828 A30-830 A30-832
7. Same as 5 except transmitters are located in separate cases at approaches	wired main unwired main wired approach unwired approach	A30-833 A30-835 A30-837 A30-839	A30-834 A30-836 A30-838 A30-840

D. ALUMINUM CASES FOR FLASHING LIGHTS AND CROSSING GATES		CATALOG NUMBER SINGLE TRACK	CATALOG NUMBER DOUBLE TRACK
1. A-c rectified with island	wired unwired	A30-851 A30-853	A30-852 A30-854
2. A-c rectified with d-c island	wired unwired	A30-855 A30-857	A30-856 A30-858
3. D-c with island	wired main unwired main wired approach unwired approach	A30-859 A30-861 A30-863 A30-865	A30-860 A30-862 A30-864 A30-866
4. FSO with overlap (Includes remote coupling case A92-750)	wired unwired	A30-867 A30-869	A30-868 A30-870
5. FSO with island (Includes remote coupling case A92-750)	wired unwired	A30-871 A30-873	A30-872 A30-874
6. Same as 4 except transmitters are located in separate cases at approaches	wired main unwired main wired approach unwired approach	A30-875 A30-877 A30-879 A30-881	A30-876 A30-878 A30-880 A30-882
7. Same as 5 except transmitters are located in separate cases at approaches	wired main unwired main wired approach unwired approach	A30-883 A30-885 A30-887 A30-889	A30-884 A30-886 A30-888 A30-890

PRE-ENGINEERED SYSTEMS
ORDER FORM

For a completed sample order form, see reverse side.

Railroad or company name: _____

_____ Date: _____

1. ( ) Single ( ) Double track
2. Track circuit required:
   - ( ) A-c rectified (Type C) with island.
   - ( ) A-c rectified with d-c island.
   - ( ) D-c with island.
   - ( ) FSO-overlap-approach channels_____ & _____
     If 2 track, channels_____ & _____
   - ( ) FSO-with island-approach channels_____ & _____; island channel_____
     If 2 track, approach channels_____ & _____; island channel_____
     ( ) Prefer remote transmitter in cases (for either FSO)
3. Equipment Case: steel ( ) or aluminum ( ), prewired ( ) or unwired ( )
4. Test Box, case mounted: yes ( ) no ( )
5. Battery Charger: nickel cadmium ( ) or lead acid ( )
6. Signal Assembly: flasher only ( ) with gate ( )
7. Gate Arm: fiberglass ( ) or wood ( ); length _____
   NOTE: Wood gate arms are available up to 38 feet; fiberglass up to 32 feet.
8. Warning Bell: none ( ) one ( ) two ( )
9. Roundel: 30° x 15° ( ) 20° x 10° ( ) 70° x 0° ( )
10. Sign: 2 track Yes ( ) No ( )

GENERAL RAILWAY SIGNAL
A UNIT OF GENERAL SIGNAL
ROCHESTER NEW YORK 14602

PRE-ENGINEERED SYSTEMS
ORDER FORM

Railroad or company name: _____

_____ Date: _____

1. (✔) Single ( ) Double track
2. Track circuit required:
   - ( ) A-c rectified (Type C) with island.
   - ( ) A-c rectified with d-c island.
   - ( ) D-c with island.
   - ( ) FSO-overlap-approach channels_____ & _____
     If 2 track, channels_____ & _____
   - (✔) FSO-with island-approach channels 12 & 13 ; island channel 25
     If 2 track, approach channels_____ & _____ ; island channel _____
   - ( ) Prefer remote transmitter in cases (for either FSO)
3. Equipment Case: steel (✔) or aluminum ( ), prewired (✔) or unwired ( )
4. Test Box, case mounted: yes ( ) no (✔)
5. Battery Charger: nickel cadmium (✔) or lead acid ( )
6. Signal Assembly: flasher only ( ) with gate (✔)
7. Gate Arm: fiberglass (✔) or wood ( ); length 22'

   NOTE: Wood gate arms are available up to 38 feet; fiberglass up to 32 feet.
8. Warning Bell: none ( ) one (✔) two ( )
9. Roundel: 30° x 15° (✔) 20° x 10° ( ) 70° x 0° ( )
10. Sign: 2 track Yes ( ) No ( )

SAMPLE

GENERAL RAILWAY SIGNAL
A UNIT OF GENERAL SIGNAL
ROCHESTER NEW YORK 14602

Folder 252A 6-77

PRE-ENGINEERED SYSTEMS
ORDER FORM

For a completed sample order form, see reverse side.

Railroad or company name: _____

_____ Date: _____

1. ( ) Single ( ) Double track
2. Track circuit required:
   ( ) A-c rectified (Type C) with island.
   ( ) A-c rectified with d-c island.
   ( ) D-c with island.
   ( ) FSO-overlap-approach channels_____ & _____
   If 2 track, channels_____ & _____
   ( ) FSO-with island-approach channels_____ & _____; island channel_____
   If 2 track, approach channels_____ & _____; island channel _____
   ( ) Prefer remote transmitter in cases (for either FSO)
3. Equipment Case: steel ( ) or aluminum ( ), prewired ( ) or unwired ( )
4. Test Box, case mounted: yes ( ) no ( )
5. Battery Charger: nickel cadmium ( ) or lead acid ( )
6. Signal Assembly: flasher only ( ) with gate ( )
7. Gate Arm: fiberglass ( ) or wood ( ); length _____
   NOTE: Wood gate arms are available up to 38 feet; fiberglass up to 32 feet.
8. Warning Bell: none ( ) one ( ) two ( )
9. Roundel: 30° x 15° ( ) 20° x 10° ( ) 70° x 0° ( )
10. Sign: 2 track Yes ( ) No ( )

GENERAL RAILWAY SIGNAL
A UNIT OF GENERAL SIGNAL
ROCHESTER NEW YORK 14602

PRE-ENGINEERED SYSTEMS
ORDER FORM

Railroad or company name: _____

_____ Date: _____

1. (✔) Single ( ) Double track
2. Track circuit required:
   - ( ) A-c rectified (Type C) with island.
   - ( ) A-c rectified with d-c island.
   - ( ) D-c with island.
   - ( ) FSO-overlap-approach channels_____ & _____
     If 2 track, channels_____ & _____
   - (✔) FSO-with island-approach channels 12 & 13 ; island channel 25
     If 2 track, approach channels_____ & _____ ; island channel _____
     ( ) Prefer remote transmitter in cases (for either FSO)
3. Equipment Case: steel (✔) or aluminum ( ), prewired (✔) or unwired ( )
4. Test Box, case mounted: yes ( ) no (✔)
5. Battery Charger: nickel cadmium (✔) or lead acid ( )
6. Signal Assembly: flasher only ( ) with gate (✔)
7. Gate Arm: fiberglass (✔) or wood ( ); length 22'
   NOTE: Wood gate arms are available up to 38 feet; fiberglass up to 32 feet.
8. Warning Bell: none ( ) one (✔) two ( )
9. Roundel: 30° x 15° (✔) 20° x 10° ( ) 70° x 0° ( )
10. Sign: 2 track Yes ( ) No ( )

SAMPLE

GENERAL RAILWAY SIGNAL
A UNIT OF GENERAL SIGNAL
ROCHESTER NEW YORK 14602

PRE-ENGINEERED SYSTEMS
ORDER FORM

For a completed sample order form, see reverse side.

Railroad or company name: _____

_____ Date: _____

1. ( ) Single ( ) Double track
2. Track circuit required:
   - ( ) A-c rectified (Type C) with island.
   - ( ) A-c rectified with d-c island.
   - ( ) D-c with island.
   - ( ) FSO-overlap-approach channels_____ & _____
     If 2 track, channels_____ & _____
   - ( ) FSO-with island-approach channels_____ & _____; island channel_____
     If 2 track, approach channels_____ & _____; island channel _____
     ( ) Prefer remote transmitter in cases (for either FSO)
3. Equipment Case: steel ( ) or aluminum ( ), prewired ( ) or unwired ( )
4. Test Box, case mounted: yes ( ) no ( )
5. Battery Charger: nickel cadmium ( ) or lead acid ( )
6. Signal Assembly: flasher only ( ) with gate ( )
7. Gate Arm: fiberglass ( ) or wood ( ); length _____
   NOTE: Wood gate arms are available up to 38 feet; fiberglass up to 32 feet.
8. Warning Bell: none ( ) one ( ) two ( )
9. Roundel: 30° x 15° ( ) 20° x 10° ( ) 70° x 0° ( )
10. Sign: 2 track Yes ( ) No ( )

GENERAL RAILWAY SIGNAL
A UNIT OF GENERAL SIGNAL
ROCHESTER NEW YORK 14602

Folder 252A 6-77

PRE-ENGINEERED SYSTEMS
ORDER FORM

Railroad or company name: _____

_____ Date: _____

1. (✔) Single ( ) Double track
2. Track circuit required:
   - ( ) A-c rectified (Type C) with island.
   - ( ) A-c rectified with d-c island.
   - ( ) D-c with island.
   - ( ) FSO-overlap-approach channels_____ & _____
     If 2 track, channels_____ & _____
   - (✔) FSO-with island-approach channels 12 & 13 ; island channel 25
     If 2 track, approach channels_____ & _____ ; island channel _____
     ( ) Prefer remote transmitter in cases (for either FSO)
3. Equipment Case: steel (✔) or aluminum ( ), prewired (✔) or unwired ( )
4. Test Box, case mounted: yes ( ) no (✔)
5. Battery Charger: nickel cadmium (✔) or lead acid ( )
6. Signal Assembly: flasher only ( ) with gate (✔)
7. Gate Arm: fiberglass (✔) or wood ( ); length 22'
   NOTE: Wood gate arms are available up to 38 feet; fiberglass up to 32 feet.
8. Warning Bell: none ( ) one (✔) two ( )
9. Roundel: 30° x 15° (✔) 20° x 10° ( ) 70° x 0° ( )
10. Sign: 2 track Yes ( ) No ( )

SAMPLE

GENERAL RAILWAY SIGNAL
A UNIT OF GENERAL SIGNAL
ROCHESTER NEW YORK 14602

DESIGN QUESTIONNAIRE

RAIL-HIGHWAY GRADE CROSSING WARNING SYSTEM

Completion of this questionnaire will enable GRS engineers to process your inquiry/order and begin work on your crossing needs immediately.

In addition to this questionnaire, please provide a scaled track plan with all existing switches, signals, and/or any other electric/electronic device(s), and insulated joints. Orders, especially, should be provided with current tie-in plans.

Railroad or company name: _____ Date: _____

Operations:

1. Length of approaches _____
2. Speed of trains _____
3. Direction of traffic _____
4. Number of trains in 24 hours _____
5. Motive power: diesel _____ electric _____
   If electric, give particulars about voltage, frequency, return current through rails and whether track circuits are single or double rail.
   _____
   _____
6. Describe all special moves made or to be made in approaches, particularly over switches:
   _____
   _____

Track Circuit Preferred (check one):

1. _____ A-c rectified with island
2. _____ A-c rectified with d-c island
3. _____ D-c with island
4. _____ Frequency shift overlay (FSO)
   a. _____ Overlap _____ Island
   b. _____ Central _____ Remote transmitters
   c. If you have channel preferences please list frequencies:
      Track 1: _____ approach _____ approach _____ island
      Track 2: _____ approach _____ approach _____ island
      Additional tracks – list as above _____
   d. Do you require a separate battery for B12 energy?
      _____ yes _____ no
   e. If there are existing electronic track circuits, please state frequencies:
      _____ _____ _____ and manufacturer _____
   f. Please list FSO options desired (See GRS Catalog 92-2): _____
      _____
      _____

(over)

Cases:

1. Size preferred _____ or GRS engineer's choice _____
2. Steel _____ aluminum _____
3. Prewired_____ unwired _____

Battery:

1. Whatever your track circuit preference, please state if standby battery is required.
   _____ yes _____ no
   If yes, hours required _____
2. Nickel cadmium _____ lead acid _____
3. In case _____ separate box _____

Signal Assemblies:

1. Flashers only _____
   Flashers with gates: wood _____ fiberglass _____ length of gate _____
   NOTE: Wood gate arms are available up to 38 feet and fiberglass up to 32 feet.
2. Cantilever:
   Length of arm _____ ft fixed _____ adjustable _____
   Walkout _____Yes _____ No
   Locking guards for ladder _____ Yes _____ No
   Unless otherwise requested, base mounting holes will be on 19 inch centers.
3. Any signal assembly:
   Signs: _____ railroad _____ railway crossing
   _____ 2 _____ 3 _____ 4 track _____Other
   XC signal units per main roadway arm ____ 2 ____4
   When required: XC signal units per roadway arm facing to left____ or right _____
   Roundel: _____° spread _____° deflection
   Lamp: _____ voltage _____ wattage
   Bell: _____ none _____ one _____ two

Test Box: _____ yes _____ no Where mounted? _____

Please include any pertinent information that will assist GRS with the design of your crossing system.

_____

_____

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_____

GENERAL RAILWAY SIGNAL
A UNIT OF GENERAL SIGNAL
ROCHESTER NEW YORK 14602

DESIGN QUESTIONNAIRE
RAIL-HIGHWAY GRADE CROSSING WARNING SYSTEM

Completion of this questionnaire will enable GRS engineers to process your inquiry/order and begin work on your crossing needs immediately.

In addition to this questionnaire, please provide a scaled track plan with all existing switches, signals, and/or any other electric/electronic device(s), and insulated joints. Orders, especially, should be provided with current tie-in plans.

Railroad or company name: _____ Date: _____

Operations:

1. Length of approaches _____
2. Speed of trains _____
3. Direction of traffic _____
4. Number of trains in 24 hours _____
5. Motive power: diesel _____ electric _____
   If electric, give particulars about voltage, frequency, return current through rails and whether track circuits are single or double rail.
   _____
   _____
6. Describe all special moves made or to be made in approaches, particularly over switches:
   _____
   _____

Track Circuit Preferred (check one):

1. _____ A-c rectified with island
2. _____ A-c rectified with d-c island
3. _____ D-c with island
4. _____ Frequency shift overlay (FSO)
   a. _____ Overlap _____ Island
   b. _____ Central _____ Remote transmitters
   c. If you have channel preferences please list frequencies:
      Track 1: _____ approach _____ approach _____ island
      Track 2: _____ approach _____ approach _____ island
      Additional tracks – list as above _____
   d. Do you require a separate battery for B12 energy?
      _____ yes _____ no
   e. If there are existing electronic track circuits, please state frequencies:
      _____ _____ _____ and manufacturer _____
   f. Please list FSO options desired (See GRS Catalog 92-2): _____
      _____
      _____

(over)

Cases:

1. Size preferred _____ or GRS engineer's choice _____
2. Steel _____ aluminum _____
3. Prewired _____ unwired _____

Battery:

1. Whatever your track circuit preference, please state if standby battery is required.
   _____ yes _____ no
   If yes, hours required _____
2. Nickel cadmium _____ lead acid _____
3. In case _____ separate box _____

Signal Assemblies:

1. Flashers only _____
   Flashers with gates: wood _____ fiberglass _____ length of gate _____
   NOTE: Wood gate arms are available up to 38 feet and fiberglass up to 32 feet.
2. Cantilever:
   Length of arm _____ ft fixed _____ adjustable _____
   Walkout _____ Yes _____ No
   Locking guards for ladder _____ Yes _____ No
   Unless otherwise requested, base mounting holes will be on 19 inch centers.
3. Any signal assembly:
   Signs: _____ railroad _____ railway crossing
   _____ 2 _____ 3 _____ 4 track _____ Other
   XC signal units per main roadway arm _____ 2 _____ 4
   When required: XC signal units per roadway arm facing to left _____ or right _____
   Roundel: _____° spread _____° deflection
   Lamp: _____ voltage _____ wattage
   Bell: _____ none _____ one _____ two

Test Box: _____ yes _____ no Where mounted? _____

Please include any pertinent information that will assist GRS with the design of your crossing system.

_____

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GENERAL RAILWAY SIGNAL
A UNIT OF GENERAL SIGNAL
ROCHESTER NEW YORK 14602

GRS CATALOG 30-1

DESIGN QUESTIONNAIRE
RAIL-HIGHWAY GRADE CROSSING WARNING SYSTEM

Completion of this questionnaire will enable GRS engineers to process your inquiry/order and begin work on your crossing needs immediately.

In addition to this questionnaire, please provide a scaled track plan with all existing switches, signals, and/or any other electric/electronic device(s), and insulated joints. Orders, especially, should be provided with current tie-in plans.

Railroad or company name: _____ Date: _____

Operations:

1. Length of approaches _____
2. Speed of trains _____
3. Direction of traffic _____
4. Number of trains in 24 hours _____
5. Motive power: diesel _____ electric _____
   If electric, give particulars about voltage, frequency, return current through rails and whether track circuits are single or double rail.
   _____
   _____
6. Describe all special moves made or to be made in approaches, particularly over switches:
   _____
   _____

Track Circuit Preferred (check one):

1. _____ A-c rectified with island
2. _____ A-c rectified with d-c island
3. _____ D-c with island
4. _____ Frequency shift overlay (FSO)
   a. _____ Overlap _____ Island
   b. _____ Central _____ Remote transmitters
   c. If you have channel preferences please list frequencies:
      Track 1: _____ approach _____ approach _____ island
      Track 2: _____ approach _____ approach _____ island
      Additional tracks – list as above _____
   d. Do you require a separate battery for B12 energy?
      _____ yes _____ no
   e. If there are existing electronic track circuits, please state frequencies:
      _____ _____ _____ and manufacturer _____
   f. Please list FSO options desired (See GRS Catalog 92-2): _____
      _____
      _____

(over)

Cases:

1. Size preferred _____ or GRS engineer's choice _____
2. Steel _____ aluminum _____
3. Prewired_____ unwired _____

Battery:

1. Whatever your track circuit preference, please state if standby battery is required.
   _____ yes _____ no
   If yes, hours required _____
2. Nickel cadmium _____ lead acid _____
3. In case _____ separate box _____

Signal Assemblies:

1. Flashers only _____
   Flashers with gates: wood _____ fiberglass _____ length of gate _____
   NOTE: Wood gate arms are available up to 38 feet and fiberglass up to 32 feet.
2. Cantilever:
   Length of arm _____ ft fixed _____ adjustable _____
   Walkout _____Yes _____ No
   Locking guards for ladder _____ Yes _____ No
   Unless otherwise requested, base mounting holes will be on 19 inch centers.
3. Any signal assembly:
   Signs: _____ railroad _____ railway crossing
   _____ 2 _____ 3 _____ 4 track _____Other
   XC signal units per main roadway arm ____ 2 ____4
   When required: XC signal units per roadway arm facing to left____ or right _____
   Roundel: _____° spread _____° deflection
   Lamp: _____ voltage _____ wattage
   Bell: _____ none _____ one _____ two

Test Box: _____ yes _____ no Where mounted? _____

Please include any pertinent information that will assist GRS with the design of your crossing system.

_____

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GENERAL RAILWAY SIGNAL
A UNIT OF GENERAL SIGNAL
ROCHESTER NEW YORK 14602

DESIGN QUESTIONNAIRE

RAIL-HIGHWAY GRADE CROSSING WARNING SYSTEM

Completion of this questionnaire will enable GRS engineers to process your inquiry/order and begin work on your crossing needs immediately.

In addition to this questionnaire, please provide a scaled track plan with all existing switches, signals, and/or any other electric/electronic device(s), and insulated joints. Orders, especially, should be provided with current tie-in plans.

Railroad or company name: _____ Date: _____

Operations:

1. Length of approaches _____
2. Speed of trains _____
3. Direction of traffic _____
4. Number of trains in 24 hours _____
5. Motive power: diesel _____ electric _____
   If electric, give particulars about voltage, frequency, return current through rails and whether track circuits are single or double rail.
   _____
   _____
6. Describe all special moves made or to be made in approaches, particularly over switches:
   _____
   _____

Track Circuit Preferred (check one):

1. _____ A-c rectified with island
2. _____ A-c rectified with d-c island
3. _____ D-c with island
4. _____ Frequency shift overlay (FSO)
   a. _____ Overlap _____ Island
   b. _____ Central _____ Remote transmitters
   c. If you have channel preferences please list frequencies:
      Track 1: _____ approach _____ approach _____ island
      Track 2: _____ approach _____ approach _____ island
      Additional tracks – list as above _____
   d. Do you require a separate battery for B12 energy?
      _____ yes _____ no
   e. If there are existing electronic track circuits, please state frequencies:
      _____ _____ _____ and manufacturer _____
   f. Please list FSO options desired (See GRS Catalog 92-2): _____
      _____
      _____

(over)

Cases:

1. Size preferred _____ or GRS engineer's choice _____
2. Steel _____ aluminum _____
3. Prewired_____ unwired _____

Battery:

1. Whatever your track circuit preference, please state if standby battery is required.
   _____ yes _____ no
   If yes, hours required _____
2. Nickel cadmium _____ lead acid _____
3. In case _____ separate box _____

Signal Assemblies:

1. Flashers only _____
   Flashers with gates: wood _____ fiberglass _____ length of gate _____
   NOTE: Wood gate arms are available up to 38 feet and fiberglass up to 32 feet.
2. Cantilever:
   Length of arm _____ ft fixed _____ adjustable _____
   Walkout _____Yes _____ No
   Locking guards for ladder _____ Yes _____ No
   Unless otherwise requested, base mounting holes will be on 19 inch centers.
3. Any signal assembly:
   Signs: _____ railroad _____ railway crossing
   _____ 2 _____ 3 _____ 4 track _____Other
   XC signal units per main roadway arm ____ 2 ____4
   When required: XC signal units per roadway arm facing to left____ or right _____
   Roundel: _____° spread _____° deflection
   Lamp: _____ voltage _____ wattage
   Bell: _____ none _____ one _____ two

Test Box: _____ yes _____ no Where mounted? _____

Please include any pertinent information that will assist GRS with the design of your crossing system.

_____

_____

_____

_____

_____

_____

GENERAL RAILWAY SIGNAL
A UNIT OF GENERAL SIGNAL
ROCHESTER NEW YORK 14602

GRS

GENERAL RAILWAY SIGNAL
A UNIT OF GENERAL SIGNAL

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Telex: 978317

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GENERAL RAILWAY SIGNAL
A UNIT OF GENERAL SIGNAL
ROCHESTER NEW YORK 14602

CASES

5/1/57

CATALOG SECTION 5

Modular Steel
Instrument Cases with
Adjustable Fixtures

GENERAL RAILWAY SIGNAL COMPANY
ROCHESTER, NEW YORK

April 1957

CATALOG SECTION 5

Modular Steel Instrument Cases with Adjustable Fixtures

CONTENTS

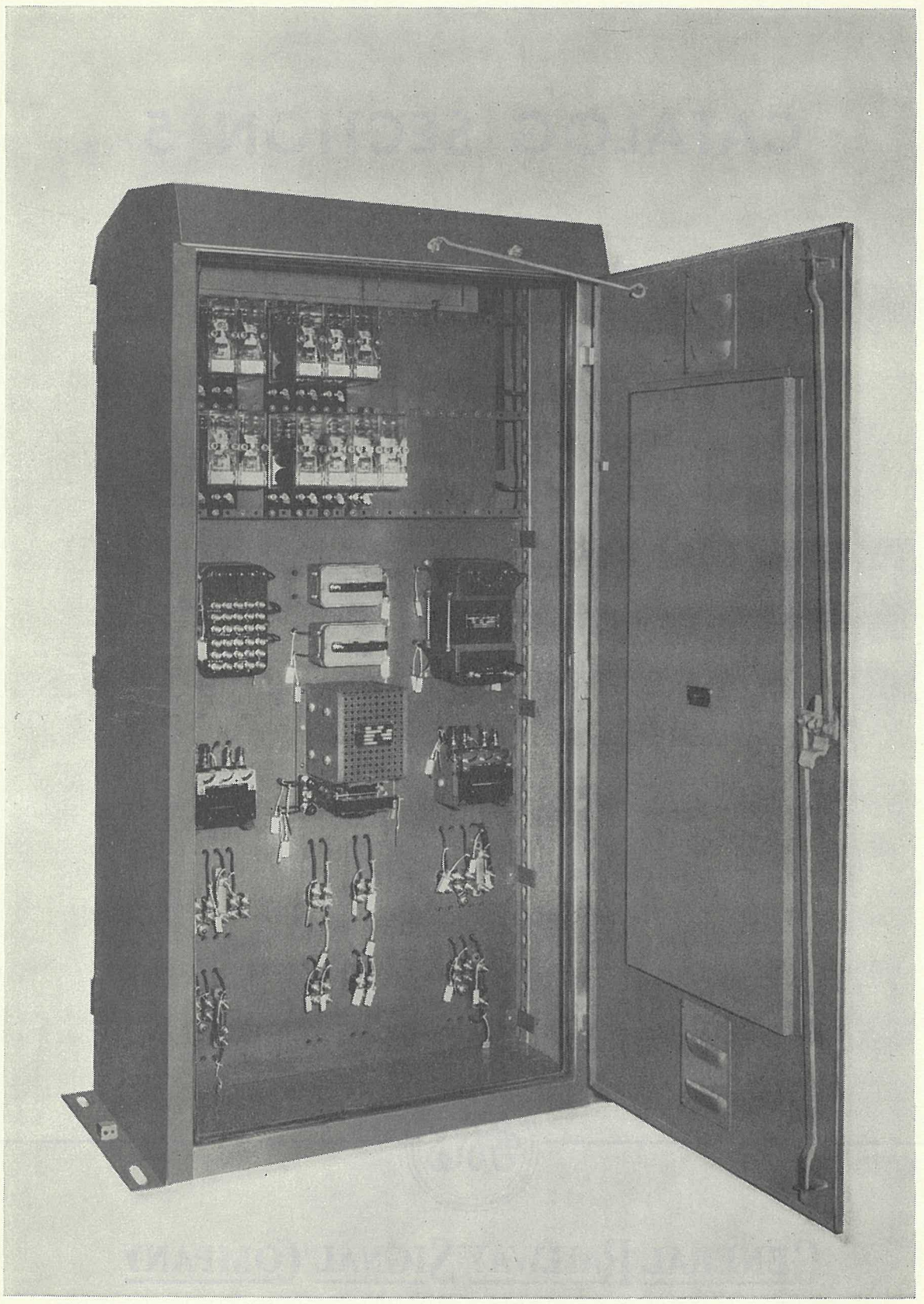
	Page
Low-Single Case	4
High-Single Case	4
Low-Double Case	5
High-Double Case	5
Half Case	6
Single-Door Case	6
Shelving and Battery Trays	8-11
Typical Arrangements for Type B Relays	12-13
Adjustable Fixtures	14

GENERAL RAILWAY SIGNAL COMPANY

ROCHESTER, NEW YORK

Printed in U. S. A

April 1957



High-Single Modular Steel Instrument Case.

GENERAL RAILWAY SIGNAL COMPANY
April 1957

Modular Steel Instrument Cases with Adjustable Fixtures

GENERAL DESCRIPTION

These cases are manufactured with permanently installed keyhole channels, one on each side, which provide complete flexibility in the arrangement of fixtures, relays, shelves, backboards, etc. (See pages 8-16 for ordering fixtures).

They are constructed of a heavy-gauge steel, which is strong, durable and corrosion resistant.

Eight knockouts are provided, four on each side, to which aerial couplings can be attached in the field. (Only two on single-door case—one on each side.)

Door hooks, with two clips for each hook, are provided for holding the doors open at 90 and 160 degrees on all cases except the half-size and single-door cases.

Louver type ventilators may be opened or closed by inverting louvers on the inside.

Two ground blocks drilled with two holes parallel to sides of case of 3/8" and 9/32" diameter to fit standard channel pins are provided on all cases except the half-size and single-door cases.

A steel plate with six 3 9/16" diameter knockouts is provided in bottom for cable entrance for all cases except the half-size and single-door cases which have three knockouts.

Single-door case also has an oblong knockout for use when pole mounted.

These steel plates may be installed as shown in Fig. A or reversed as shown in Fig. B, page 4.

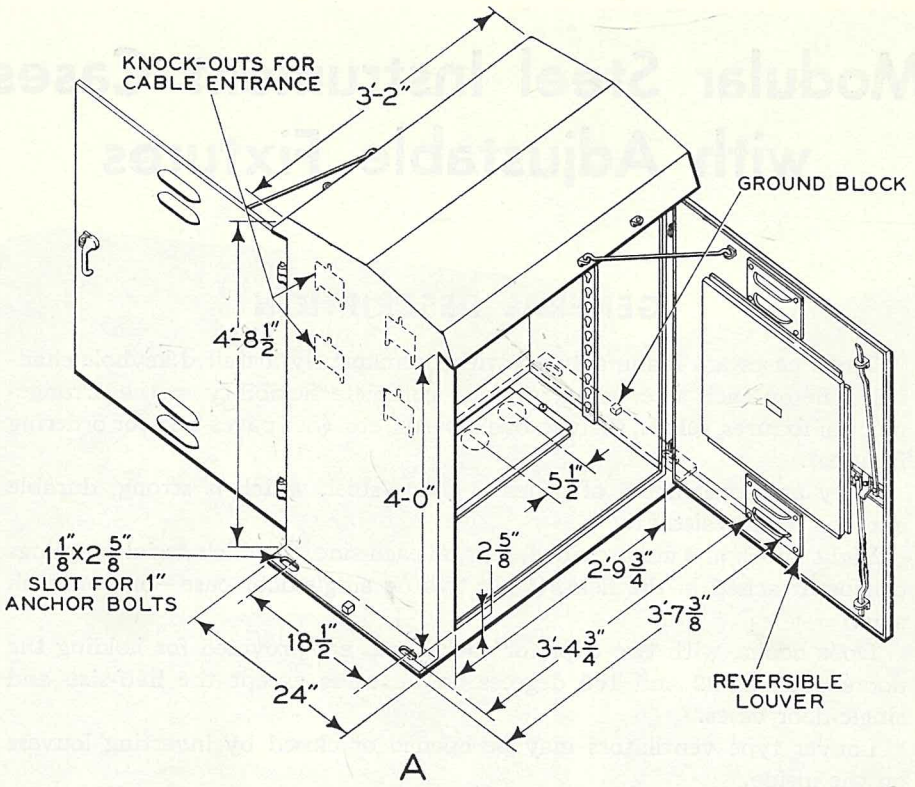
Mounting bracket for pull-chain light socket is provided in roof of case (except half-size and single-door cases).

Both front and rear doors are equipped with handles for padlocking.

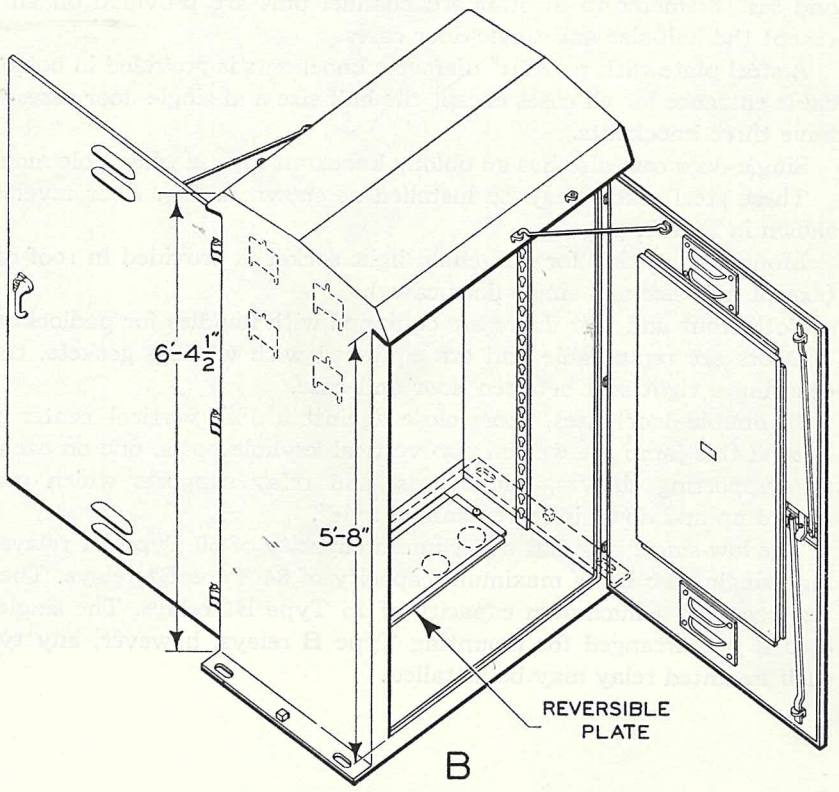
Doors are replaceable and are equipped with wicking gaskets, thereby ensuring a tight seal between door and case.

In double-door cases, doors close against a 3 3/4" vertical center jamb. Behind this jamb are welded two vertical keyhole posts, one on each side, for supporting shelves, backboards, and relay supports which may be moved up and down in increments of 2 3/16".

The low-single case has a maximum capacity of 60 Type B1 relays. The high-single case has a maximum capacity of 84 Type B1 relays. The half-size case has a maximum capacity of 25 Type B1 relays. The single-door case is not arranged for mounting Type B relays, however, any type of shelf mounted relay may be installed.



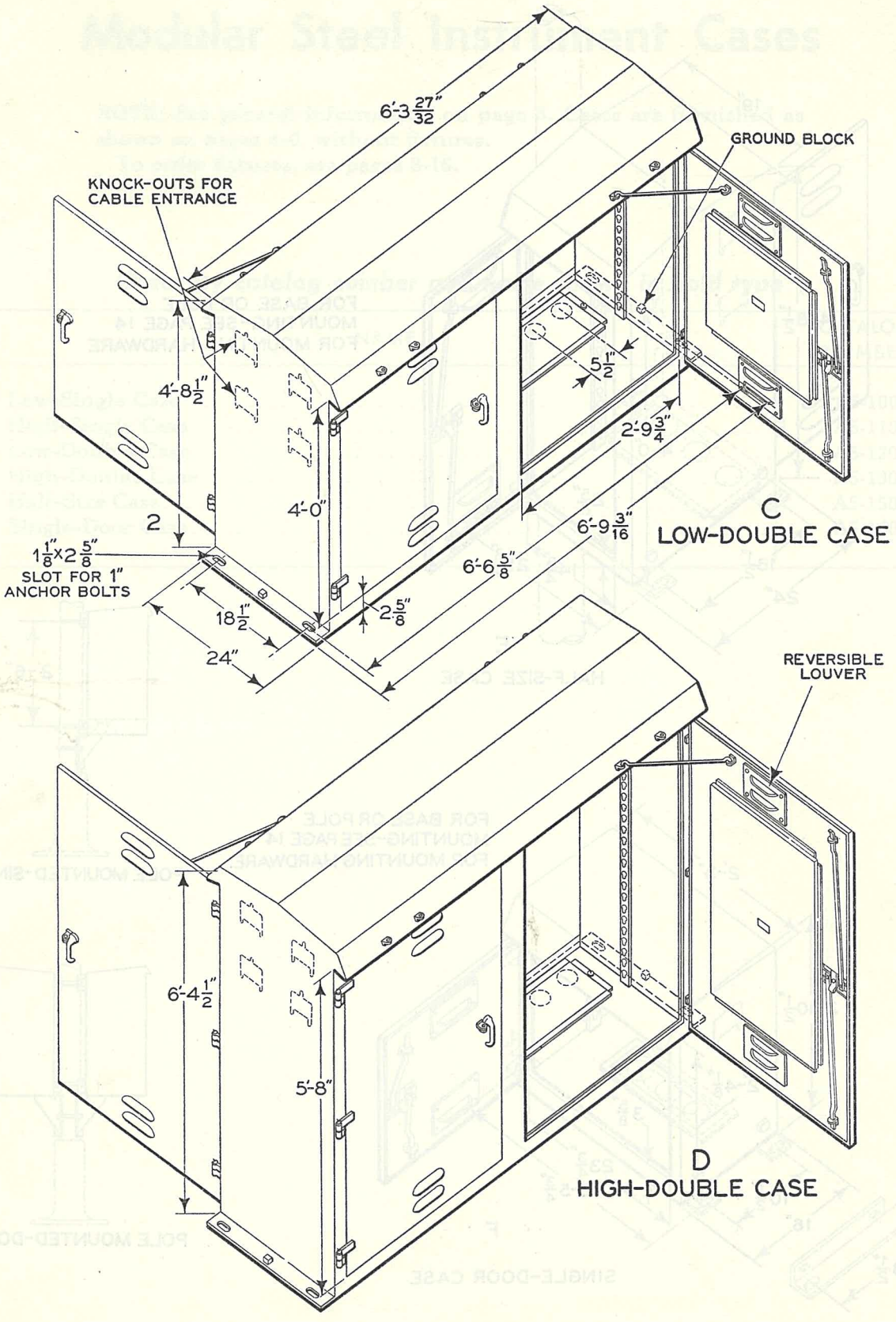
A
LOW-SINGLE CASE



B
HIGH-SINGLE CASE

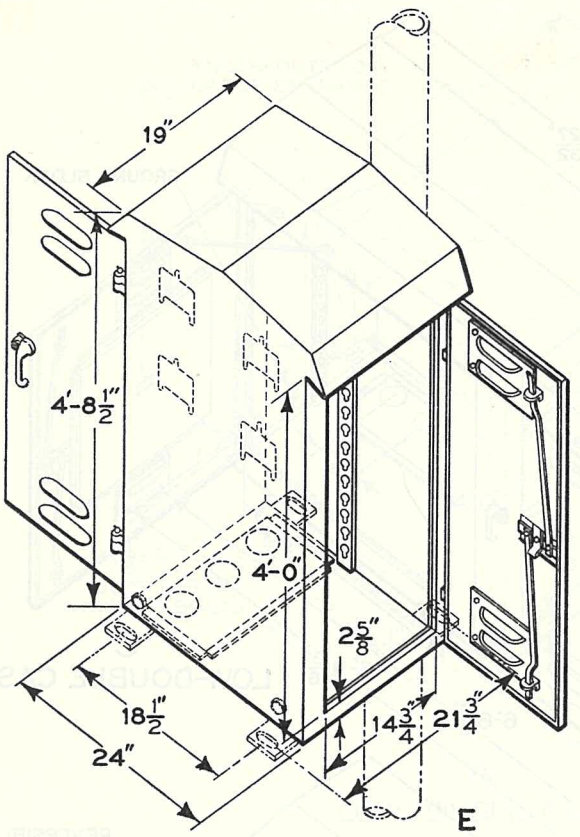
Modular Steel Instrument Cases.

GENERAL RAILWAY SIGNAL COMPANY
April 1957



Modular Steel Instrument Cases.

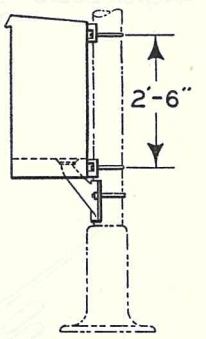
GENERAL RAILWAY SIGNAL COMPANY
April 1957



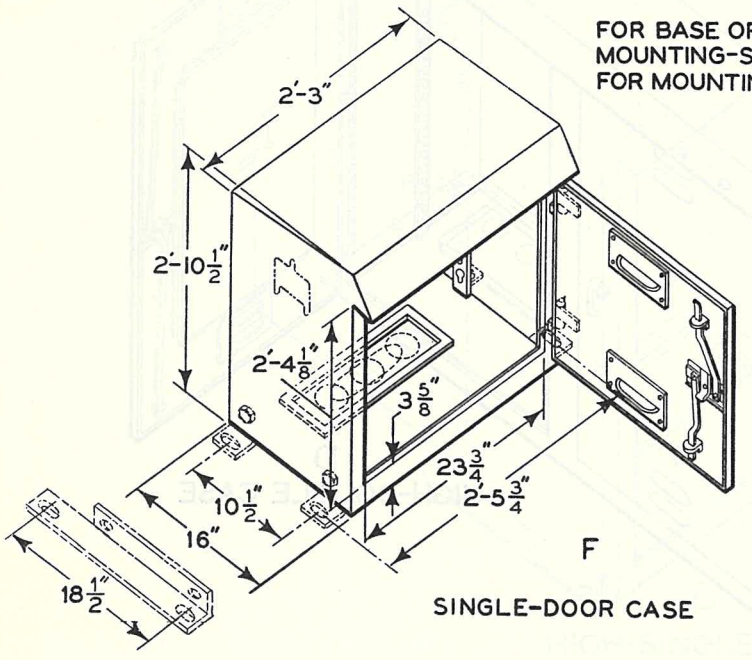
E

HALF-SIZE CASE

FOR BASE OR POLE MOUNTING-SEE PAGE 14 FOR MOUNTING HARDWARE



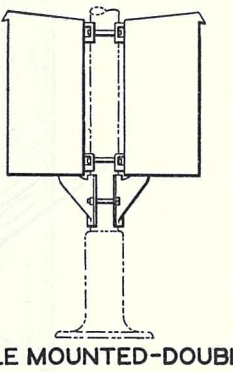
POLE MOUNTED-SINGLE



F

SINGLE-DOOR CASE

FOR BASE OR POLE MOUNTING-SEE PAGE 14 FOR MOUNTING HARDWARE.



POLE MOUNTED-DOUBLE

Modular Steel Instrument Cases.

GENERAL RAILWAY SIGNAL COMPANY
April 1957

Modular Steel Instrument Cases

NOTE: See general information on page 3. Cases are furnished as shown on pages 4-6, without fixtures.
To order fixtures, see pages 8-16.

Order by catalog number and name shown in bold type

REF.	NAME	CATALOG NUMBER
A	**Low-Single Case**	A5-100
B	**High-Single Case**	A5-110
C	**Low-Double Case**	A5-120
D	**High-Double Case**	A5-130
E	**Half-Size Case**	A5-150
F	**Single-Door Case**	A5-160

GENERAL RAILWAY SIGNAL COMPANY
April 1957

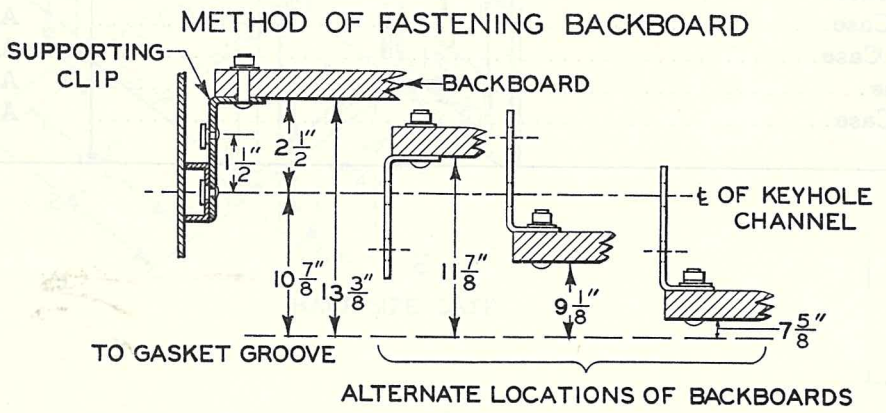
Typical Arrangements of Shelving and Battery Trays

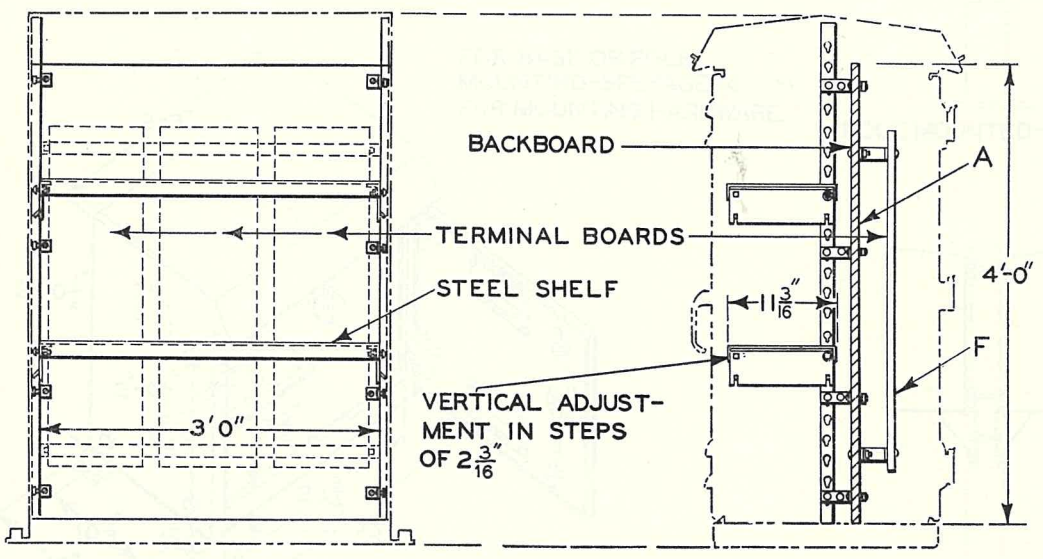
NOTE: The sketches shown on pages 8 to 11 illustrate a few of the many possible arrangements of backboards, terminal boards, steel shelves, battery trays and covers.

The backboard may be shifted from front to back by moving the supporting clips as illustrated below.

The vertical spacing of the shelves, trays, etc. may be varied in steps of $2\frac{3}{16}$".

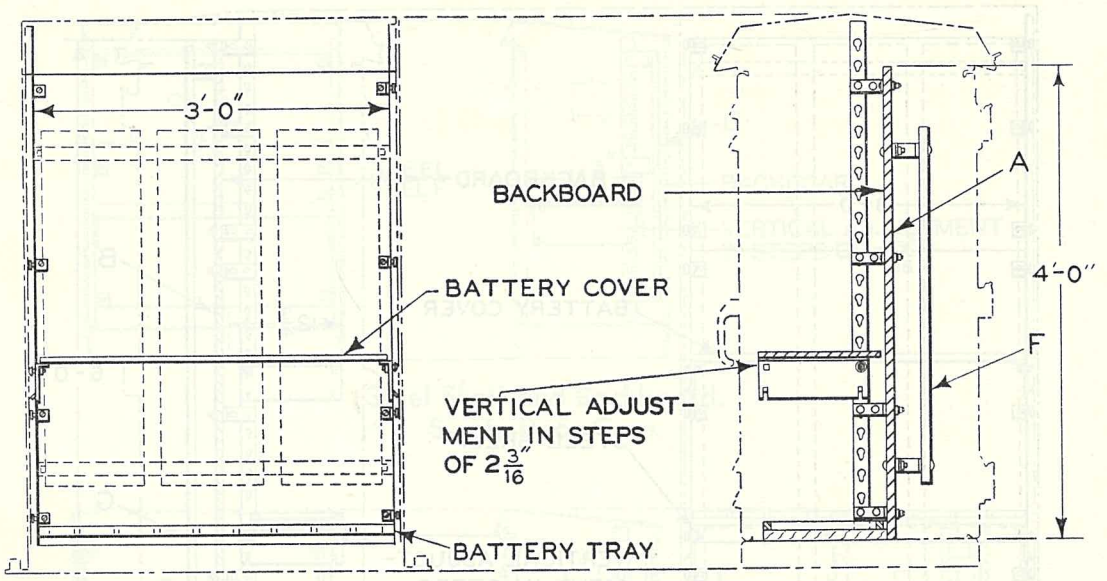
See page 14 for ordering references for detail parts.



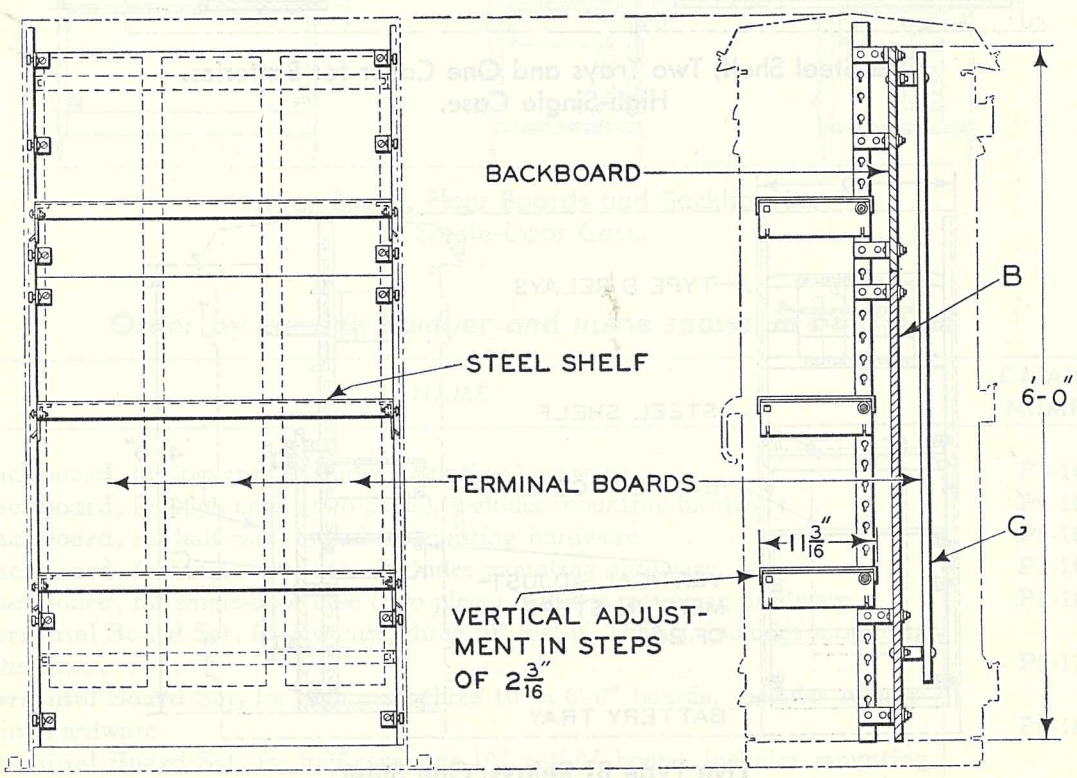


Two Steel Shelves.
Low-Single Case.

Typical Arrangements of Shelving and Battery Trays

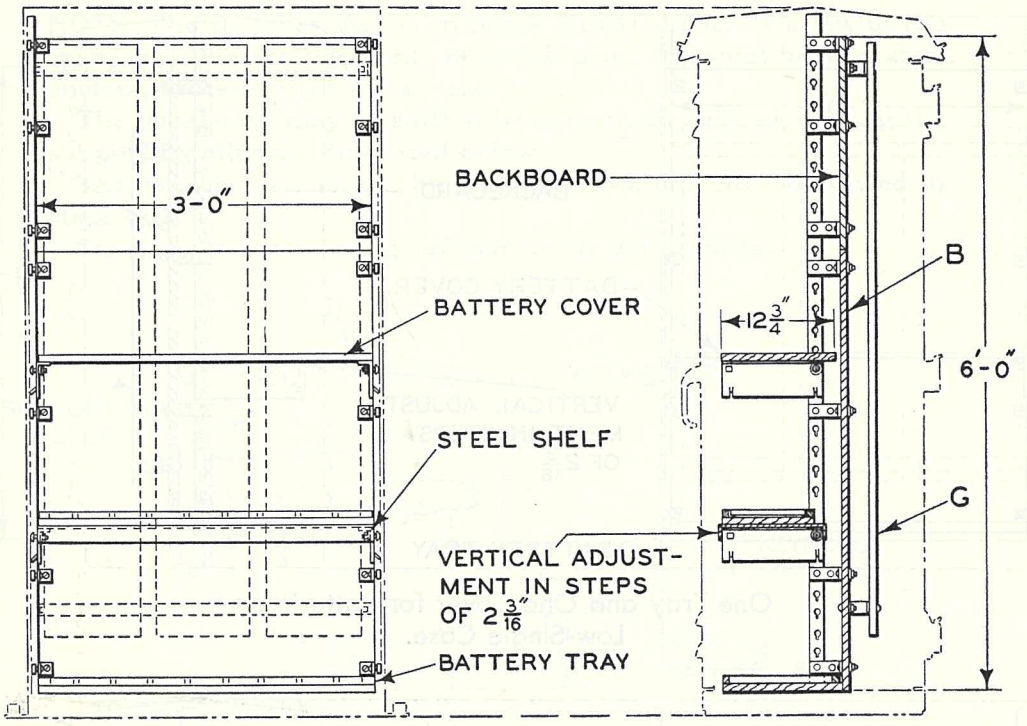


One Tray and One Cover for Batteries.
Low-Single Case.

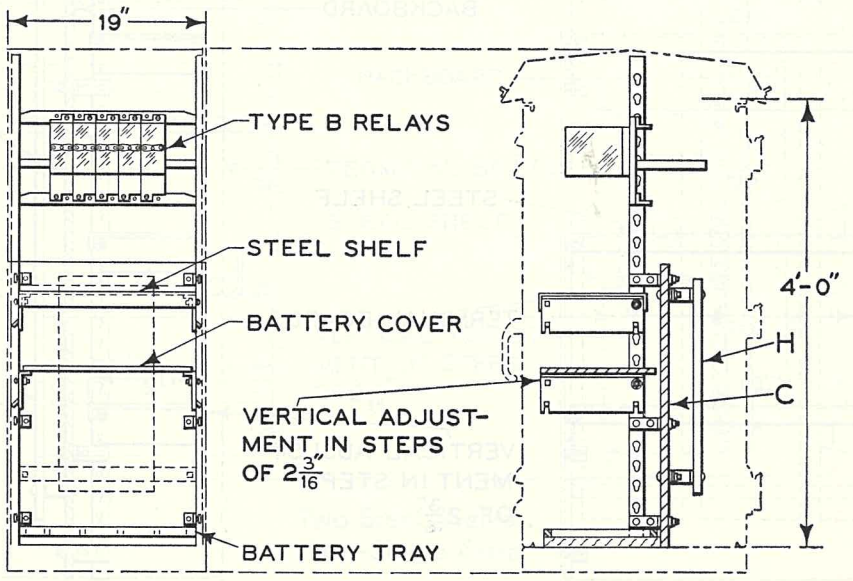


Three Steel Shelves.
High-Single Case.

Typical Arrangements of Shelving and Battery Trays

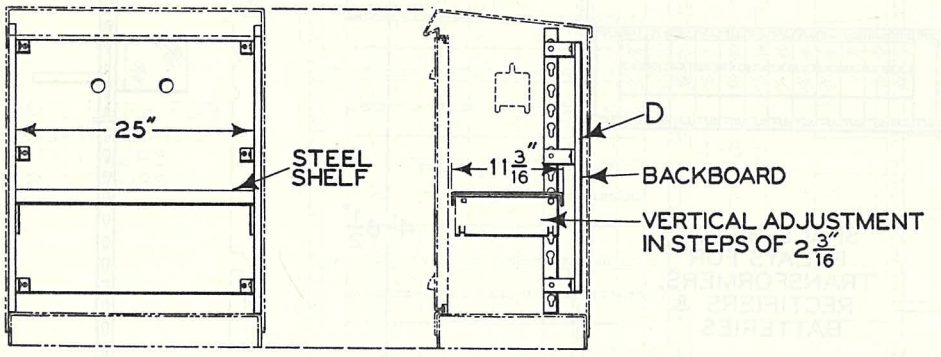


One Steel Shelf, Two Trays and One Cover for Batteries. High-Single Case.

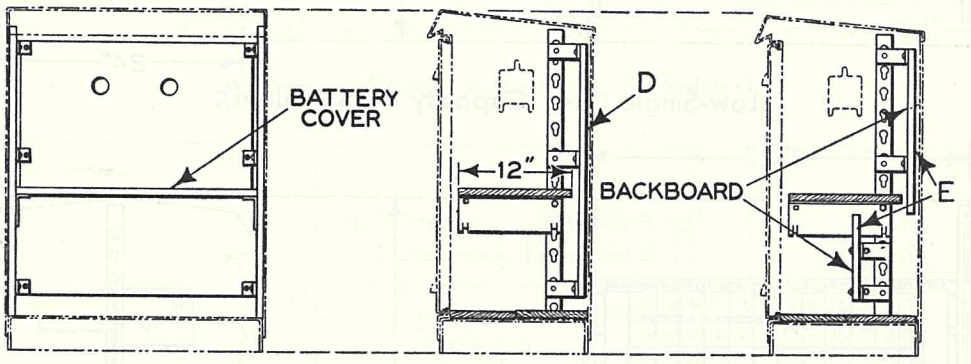


Five Type B1 Relays, One Steel Shelf, One Battery Tray and Cover. Half-Size Case.

Typical Arrangements of Shelving and Battery Trays



Steel Shelf and Backboard.
Single-Door Case.

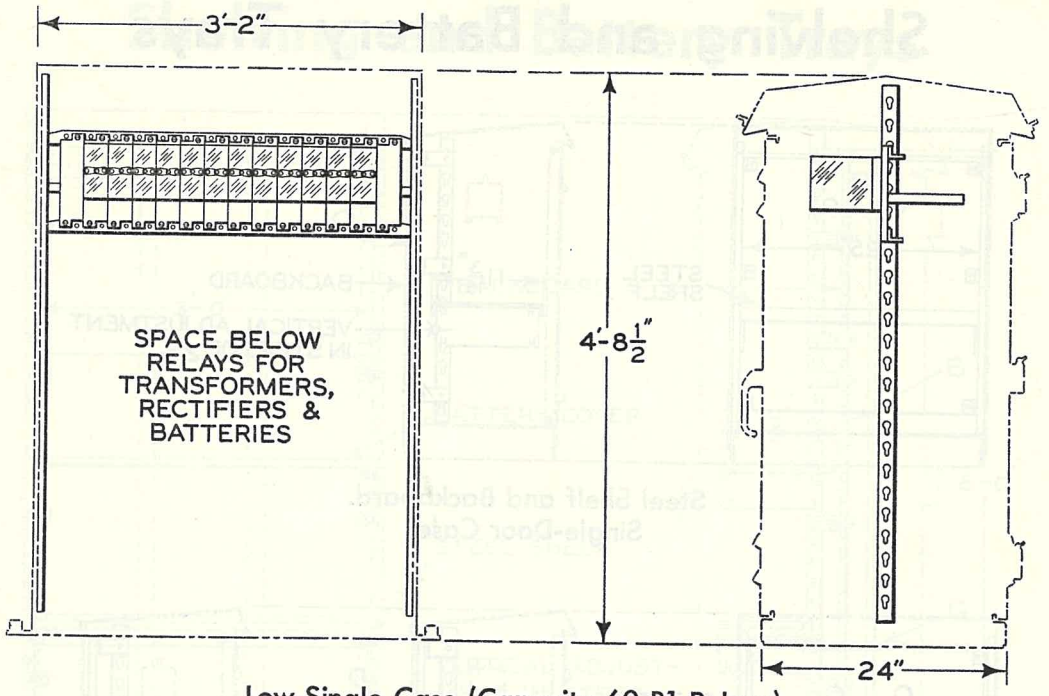


Cover Board, Floor Boards and Backboards.
Single-Door Case.

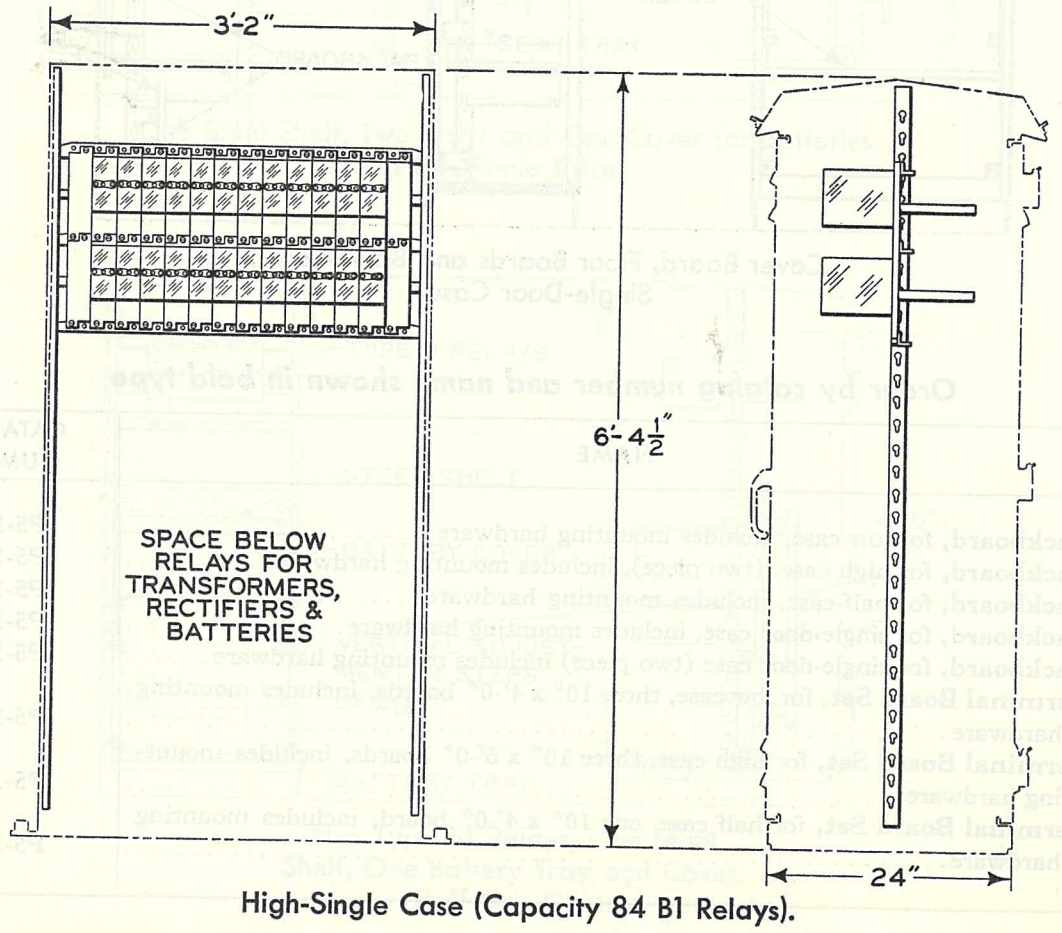
Order by catalog number and name shown in bold type

REF.	NAME	CATALOG NUMBER
A	**Backboard,** for low case, includes mounting hardware	P5-100
B	**Backboard,** for high case, (two piece), includes mounting hardware	P5-101
C	**Backboard,** for half-case, includes mounting hardware	P5-102
D	**Backboard,** for single-door case, includes mounting hardware	P5-103
E	**Backboard,** for single-door case (two piece) includes mounting hardware	P5-104
F	**Terminal Board Set,** for low case, three 10″ x 4′-0″ boards, includes mounting hardware	P5-105
G	**Terminal Board Set,** for high case, three 10″ x 6′-0″ boards, includes mounting hardware	P5-106
H	**Terminal Board Set,** for half case, one 10″ x 4′-0″ board, includes mounting hardware	P5-107

Typical Arrangements for Type B Relays



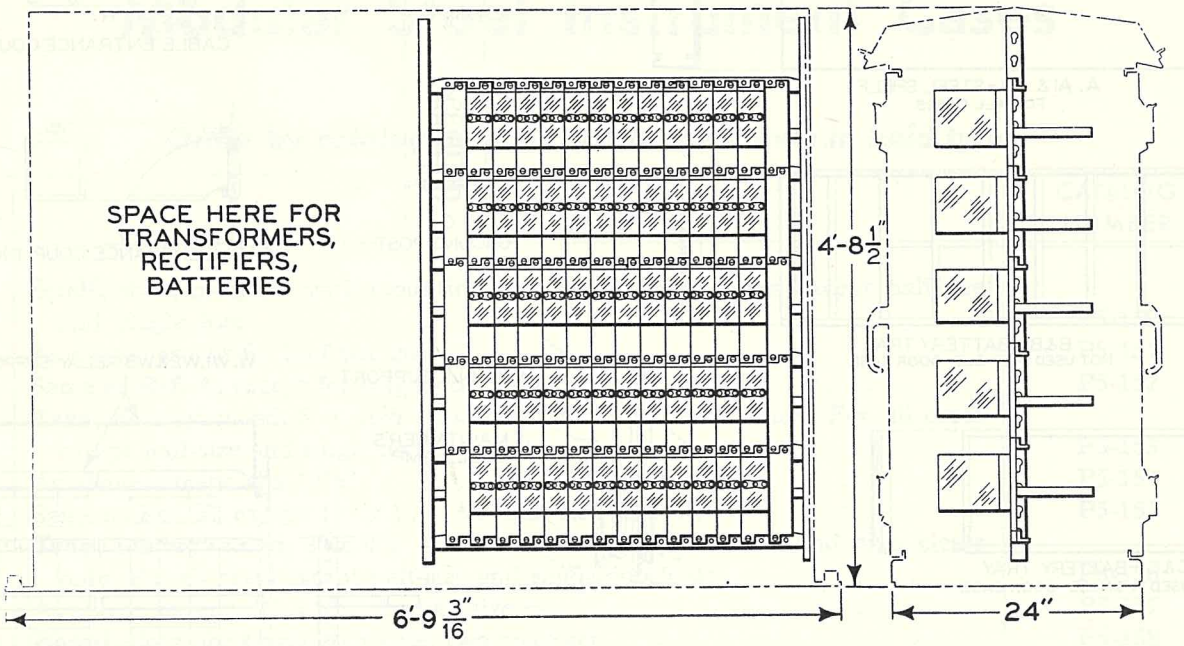
Low-Single Case (Capacity 60 B1 Relays).



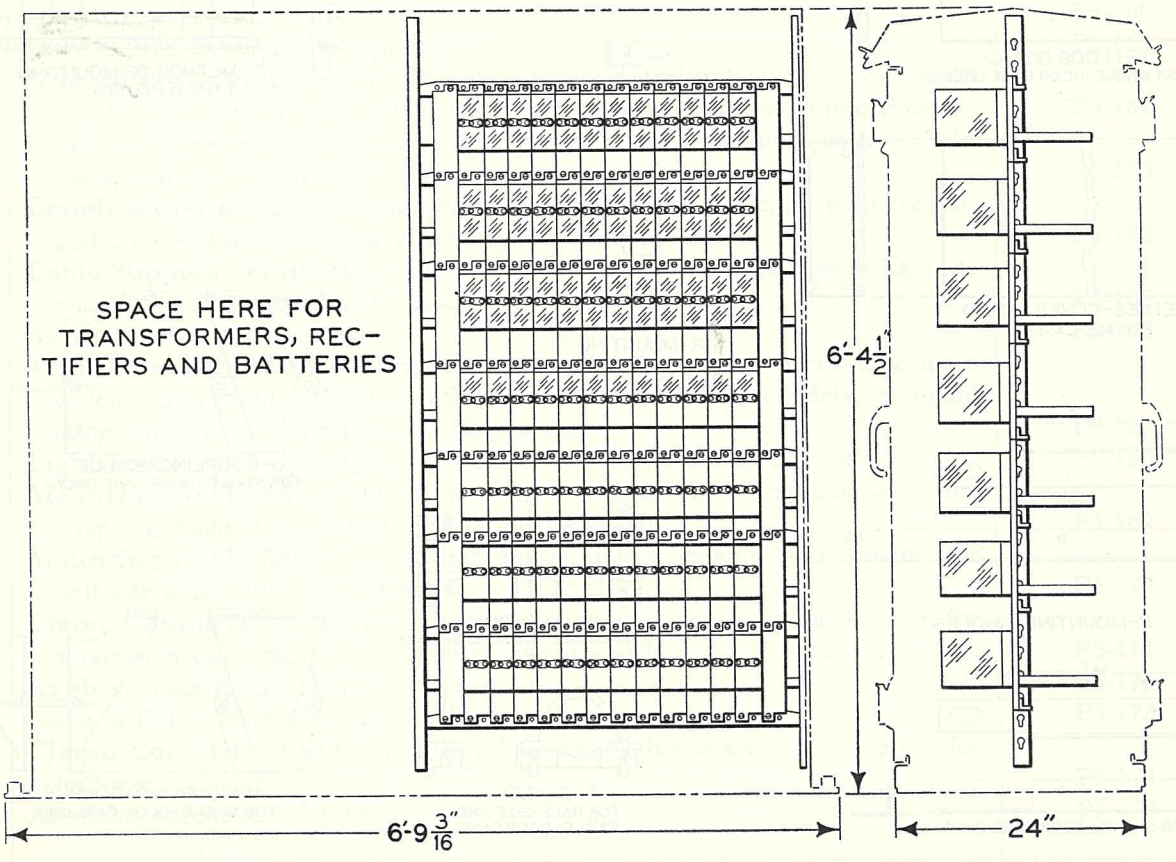
High-Single Case (Capacity 84 B1 Relays).

GENERAL RAILWAY SIGNAL COMPANY
April 1957

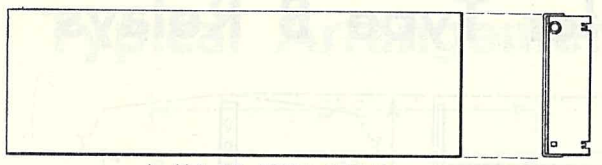
Typical Arrangements for Type B Relays



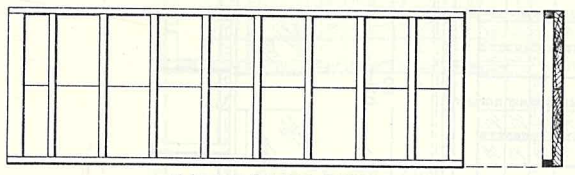
Low-Double Case (Capacity 60 B1 Relays).



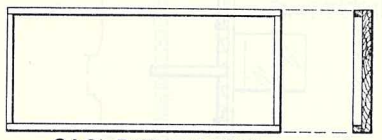
High-Double Case (Capacity 84 B1 Relays).



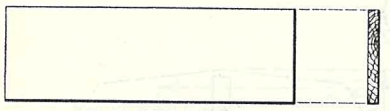
A, A1 & A2 - STEEL SHELF
FOR ALL CASES



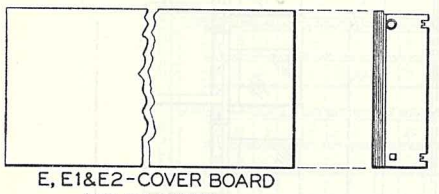
B&B1 - BATTERY TRAY
NOT USED IN SINGLE - DOOR CASE



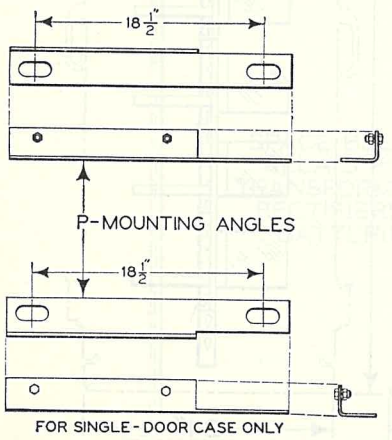
C&C1 - BATTERY TRAY
NOT USED IN SINGLE - DOOR CASE



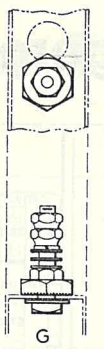
D - FLOOR BOARD
FOR SINGLE - DOOR CASE ONLY



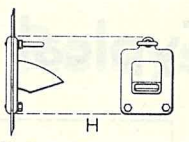
E, E1 & E2 - COVER BOARD
FOR ALL CASES



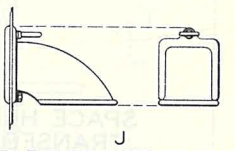
P - MOUNTING ANGLES
FOR SINGLE - DOOR CASE ONLY



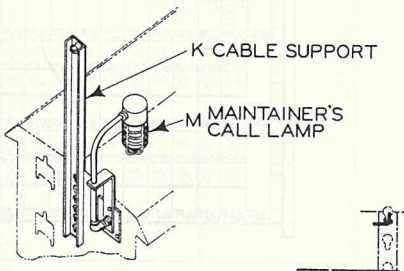
G
GROUND POST

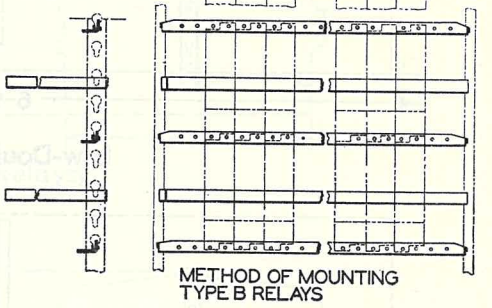


H
CABLE ENTRANCE COUPLING

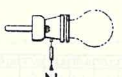


J
CABLE ENTRANCE COUPLING

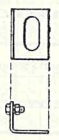




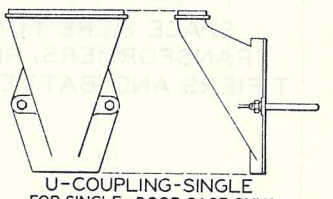
METHOD OF MOUNTING
TYPE B RELAYS



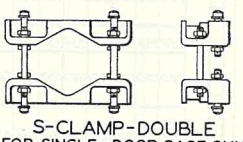
N
LIGHT SOCKET



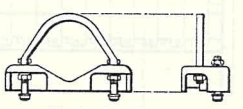
R - MOUNTING ANGLES
FOR HALF - SIZE AND SINGLE - DOOR CASE



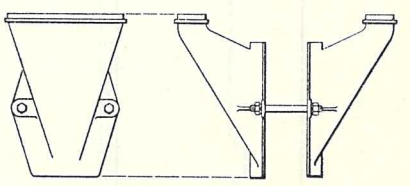
U - COUPLING - SINGLE
FOR SINGLE - DOOR CASE ONLY



S - CLAMP - DOUBLE
FOR SINGLE - DOOR CASE ONLY



T - CLAMP
FOR HALF - SIZE AND SINGLE - DOOR CASE



V - COUPLING - DOUBLE
FOR SINGLE - DOOR CASE ONLY

Fixtures for Modular Steel Instrument Cases.

GENERAL RAILWAY SIGNAL COMPANY
April 1957

Fixtures for Modular Steel Instrument Cases

Order by catalog number and name shown in bold type

REF.	NAME	CATALOG NUMBER
A	**Shelf,** steel, complete with mounting brackets. For all cases except half-size and single-door	P5-150
A1	As above, except for half-size case	P5-151
A2	Same as Ref. A, except for single-door case	P5-152
B	**Tray,** battery, wood, 3′ x 19½″ acid-resistant finish, with cleats. For all cases except half-size and single door	P5-153
B1	As above, except 3′ x 12½″	P5-154
B2	Same as Ref. B, except 17″ x 12½″ for half-size case	P5-155
C	**Tray,** battery, wood, 3′ x 9⅞″ acid-resistant finish, with end and side cleats only. For all cases except half-size and single-door case	P5-156
C1	As above, except 17″ x 9⅞″ for half-size case	P5-157
D	**Board,** floor, for single-door case, two-piece set	P5-158
E	**Board,** cover, complete with mounting brackets, acid-resistance finish. For all cases except half-size and single-door case	P5-159
E1	As above, except for half-size case	P5-160
E2	Same as Ref. E, for single-door case	P5-161
G	**Ground Post Complete,** 5/16″-18, with hardened steel nut with serrated teeth which scrapes paint from keyhole slot to ensure good ground connection	P5-162
H	**Coupling Complete,** for aerial cable entrance, 2″ x 2″ opening, with eyebolt, plate, bolts and washers for attaching to case	P5-163
J	**Coupling Complete,** for aerial cable entrance, 3⅛″ x 3¼″ opening, with eyebolt, plate, bolts and washers for attaching to case	P5-164
K	**Cable Support Complete,** for low cases, includes 1″ eyebolt, also bolts, nuts and washers for mounting to case	P5-165
K1	As above, except for high cases	P5-166
M	**Maintainer's Call Lamp Complete,** with socket for medium-screw base lamp which is also fitted with adapter for using standard, 2 pin, candelabra, signal lamp, includes all parts for mounting to case	P5-167
N	**Light Socket,** pull-chain type, includes screws for fastening to bracket	P5-168
P	**Mounting Angle Set,** includes two angles and all mounting hardware, for adapting single-door case to standard foundation	P5-169
R	**Mounting Angle Set,** includes four angles and all mounting hardware, for half-size and single-door case	P5-170
S	**Clamp Complete,** double set, includes all mounting hardware for 4″ pipe, for single-door cases only when mounted back-to-back	P5-171
S1	As above, except for 5″ pipe	P5-172
S2	Same as Ref. S, except for 6″ pipe	P5-173
T	**Clamp Complete,** single, includes all mounting hardware, for 4″ pipe, for half-size and single-door case	P5-174
T1	As above, except for 5″ pipe	P5-175

(Continued on following page)

Fixtures for Modular Steel Instrument Cases

Order by catalog number and name shown in bold type

REF.	NAME	CATALOG NUMBER
T2	Same as Ref. T, except for 6″ pipe	P5-176
U	**Coupling Complete,** single, includes all mounting hardware, for 4″ pipe, for single-door case	P5-177
U1	As above, except for 5″ pipe	P5-178
U2	Same as Ref. U, except for 6″ pipe	P5-179
V	**Coupling Complete,** double, includes all mounting hardware, for 4″ pipe, for single-door case	P5-180
V1	As above, except for 5″ pipe	P5-181
V2	Same as Ref. V, except for 6″ pipe	P5-182
W	**Relay Support,** for first (or single row) of Type B Relays, complete with wiring harness support, for all cases except half-size and single door	P5-183
W1	**Relay Support,** for first (or single row) of Type B Relays, complete with wiring harness support, for half-size case	P5-184
W2	**Relay Support,** for each additional row of Type B Relays, complete with wiring harness support, for all cases except half-size and single door	P5-185
W3	**Relay Support,** for each additional row of Type B Relays, complete with wiring harness support, for half-size case	P5-186

GENERAL RAILWAY SIGNAL COMPANY
April 1957

Modular Steel Instrument Cases
Repair Parts

Order by catalog number and name shown in bold type

NAME	CATALOG NUMBER
Door Complete, for low-single case, also right-hand for low-double case	P5-300
Door Complete, for high-single case, also right-hand for high-double case	P5-301
Door Complete, left-hand, for low-double case	P5-302
Door Complete, left-hand, for high-double case	P5-303
Door Complete, for half-size case	P5-304
Door Complete, for single-door case	P5-305
Handle, with hex. nut and washer, for door	P5-306
Hinge Pin, for doors	P5-307
Oiler, for hinge	P5-308
Gasket, 9/16″ dia., for door, specify number feet	P5-309
Baffle, reversible louver, for all cases except single-door	P5-310
Baffle, reversible louver, for single-door case	P5-311
Screen, for ventilator, for all cases except single-door	P5-312
Screen, for ventilator, for single-door case	P5-313
Latch Rod, upper, for low case, and half-size case	P5-314
Latch Rod, lower, for low case, and half-size case	P5-315
Latch Rod, upper, for high case	P5-316
Latch Rod, lower, for high case	P5-317
Latch Rod, upper, for single-door case	P5-318
Latch Rod, lower, for single-door case	P5-319
Clip, for backboard	P5-320
Shelf, steel, for all cases except half-size and single-door	P5-321
Shelf, steel, for half-size case	P5-322
Bracket, for supporting shelves and trays, includes screw, nuts and washers	P5-323

GENERAL RAILWAY SIGNAL COMPANY
April 1957

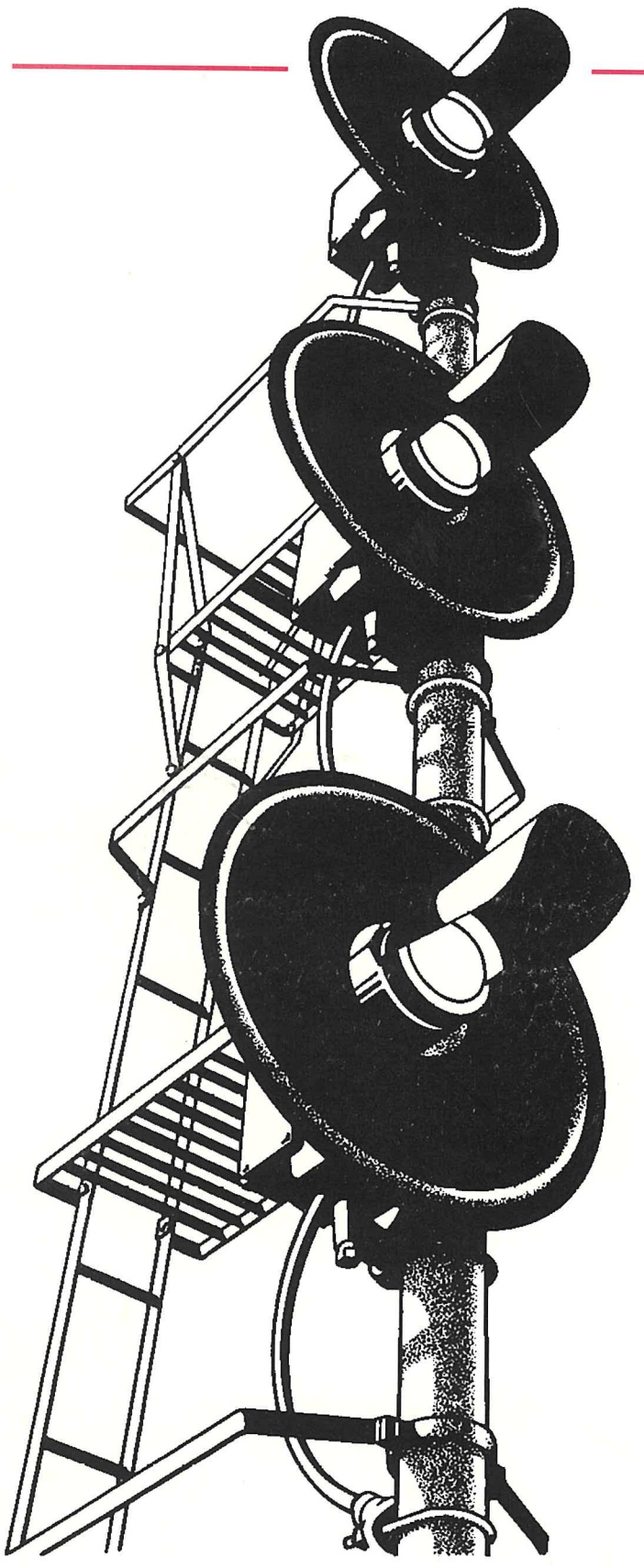
Memoranda

GENERAL RAILWAY SIGNAL COMPANY
April 1957

SEARCHLIGHT SIGNAL

TYPE SA-1
SEARCHLIGHT SIGNAL

GRS CATALOG **76-1**



FEATURES

- *Aspect-Checking Contacts Directly Operated by Counterweights*
- *Slanted Color Discs Minimize Beam Dilution*
- *Choice of Compound or Stepped Lens System*
- *Available with 20-Degree Deflecting Roundel or 30-Degree Spredlite Roundel*
- *Wide Choice of Assemblies and Wire Entrance Couplings*
- *Precision Filament Lamp Needs No Refocusing When Changing*
- *Built-In Sighting Fixture*
- *Built-In Surge Arrestor*
- *Plug-In, Cartridge-Type, Adjustable Lamp Resistor*
- *Optional Phankill Unit Reduces Beam Dilution*

CONTENTS

INTRODUCTION 3
DESCRIPTION 4
OPERATION 6
INSTALLATION 7
ORDERING INFORMATION 8
- High Signal Heads Complete 8
- High Signal Housing Less Mechanism 8
- Dwarf Signal Complete 10
- Dwarf Signal Housing Less Mechanism 10
- Operating Mechanism 12
- Inoperative Mechanism 12
- Roundels and Phankills 13
- Mast Assemblies 14
- Couplings and Conduit 16
- Ladder Support and Foundation 18
- Lamp Resistors 19
- Optional Mast Mounting Brackets 19

INTRODUCTION

The GRS Type SA-1 searchlight signal features an efficient electro-magnetic structure, maximum back contact pressure, positive contact closure, and precise color disc positioning. It operates from battery or rectified a-c — 8 to 12 volts d-c.

The Type SA-1 signal consists of a compact operating mechanism and a durable cast aluminum housing. The housing can be bracket-mounted to the side or front of the signal mast, provided with a socket for mounting on top of the mast, or provided with a base for mounting on a concrete foundation.

The Type SA-1 signal projects three aspects — red, yellow and green — through a single optical system to provide a powerful beam using minimal energy. The beam has a daylight range (with a compound lens system for tangent track) of one mile, using a 5-watt lamp. The signal automatically displays its most restrictive aspect (red) in case of a power failure or other type of circuit interruption.

The signal housing has an 8-3/8-inch lens, hood, ventilators, background, and mounting bracket, base, or mounting socket. The operating mechanism, Figure 1, slides easily into the housing on a hanger-and-track system, and is locked securely into an accurate position by cams and locking pins.

The signal is available with one of two types of lens systems: (1) compound or (2) a stepped. With the same wattage lamp, the compound lens system produces a light beam of longer range. Also available are outer roundels to spread or deflect a beam for track curvatures, and a Phankill to reduce beam dilution.

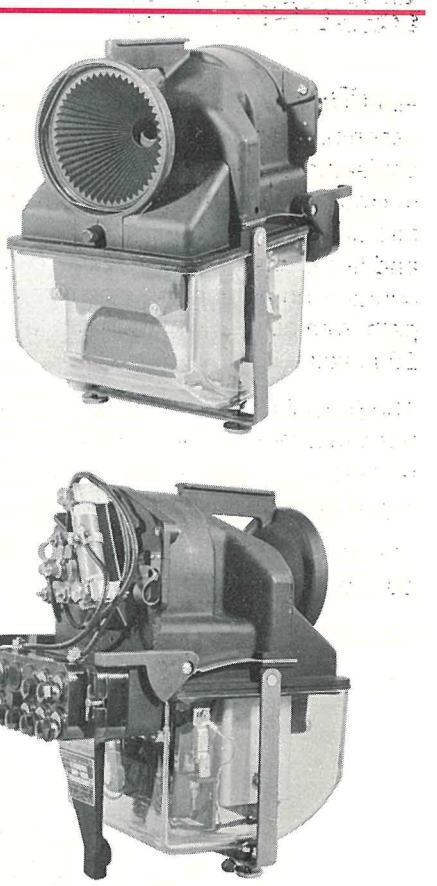
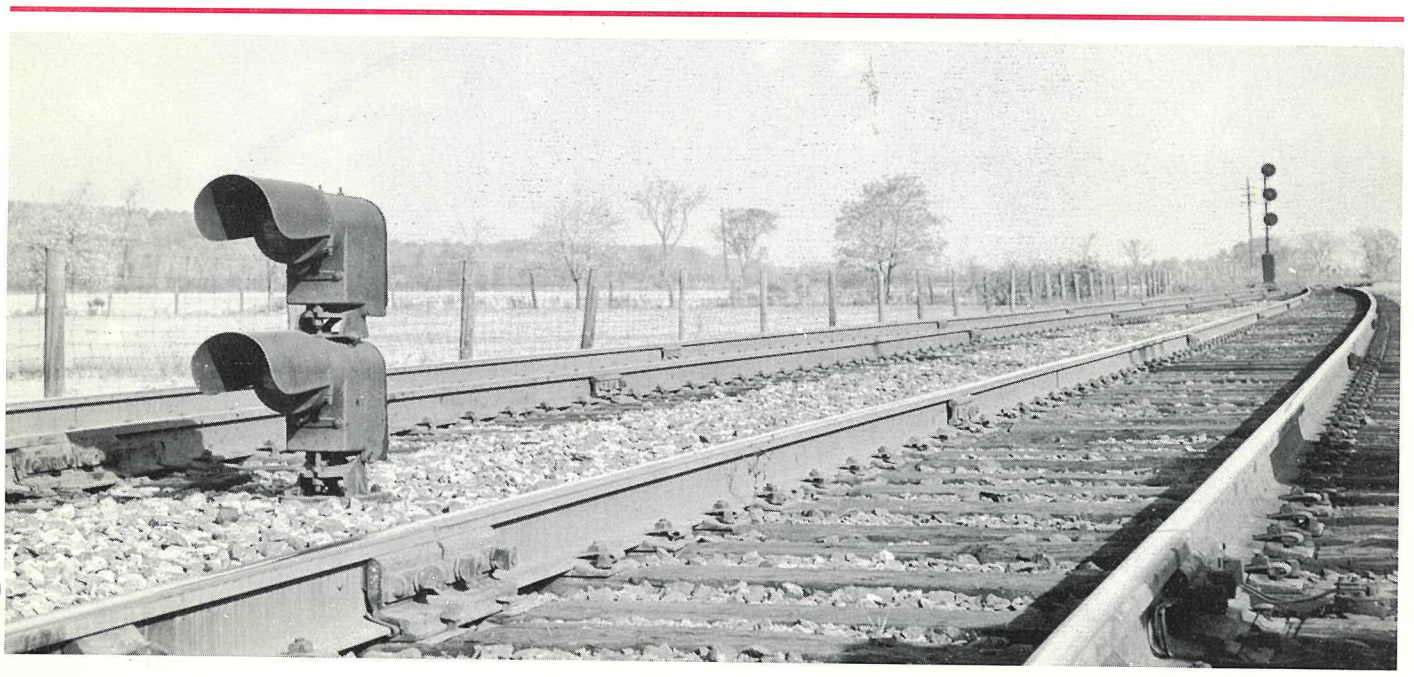


Figure 1. Type SA-1 signal mechanism.



A two-unit Type SA-1 dwarf signal, left, is teamed with a three unit Type SA-1 high signal at this field location.

DESCRIPTION

Figure 2 shows the SA-1 mechanism with the lamp assembly and plug coupler removed. The lamp assembly features a plug-in, adjustable lamp resistor, which makes it easy to match the lamp you plan to use. Resistors are available in three different resistances - one, two, and five ohms. The removable half of the plug coupler contains an air-gap lightning arrestor which provides a path from case to control wires for surges in excess of 2000 volts.

The precision filament, single contact lamp has a bayonet base that locks in place through an opening in the lamp reflector. The easily changed lamp requires no refocusing when replaced.

The mechanism uses a rotary movement principle to position a spectacle arm which carries three color discs, Figure 3. The spectacle arm is inclined toward the reflector so that each color disc is positioned just out of the maximum heat area of the reflector's focal point. This arrangement protects the color discs against thermal shock, yet provides for full, effective coloring of the light beam. Also, by slanting the color disc, dilution of the color aspect due to mirror effect is prevented, since outside light returning from the front of the signal is reflected upward, rather than back into the color beam.

The polarity of the control circuit determines whether a yellow or a green color disc is positioned in the light beam. When the circuit is deenergized, the red color disc is positioned, by gravity, to color the beam.

The "yellow" and "green" contacts provide maximum back contact pressure to ensure uniform pressure throughout

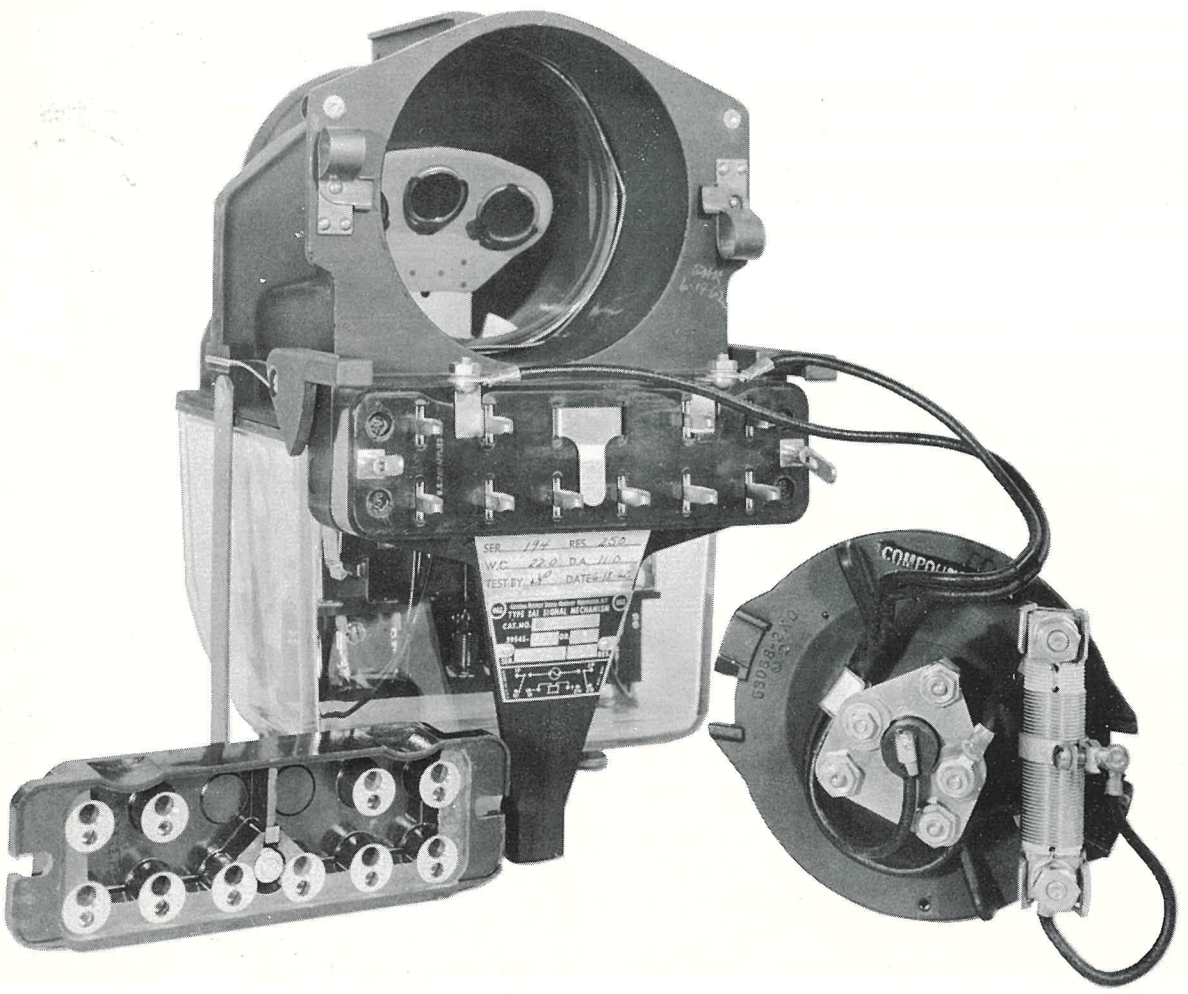


Figure 2. Type SA-1 mechanism with lamp reflector and plug coupler removed

their useful life. A large diameter flywheel, friction mounted on the spectacle shaft, provides "follow-through" inertia so that the contacts close positively, without rebound, in the green and yellow positions. Color flashes are thus eliminated. Suspension counterweights snub the contacts to a clean, solid closure in the red position.

The spectacle shaft assembly has stops of laminated phenolic, a rugged material that provides excellent, long-life service. The shaft is supported by knife edge bearings of a type which, while practically friction free, have demonstrated outstanding ability to withstand wear and vibration.

The design of the electromagnet structure allows substantial clearance between moving and stationary parts. A quarter-inch air gap ensures against interference from foreign material.

Mast-mounted Type SA-1 signals have a sighting device on top of the housing to permit easy, assurate positioning. By sighting through the hairline peep sight and manipulating the horizontal and vertical adjustments, the light beam is directed as desired. Bridge signals on girders and dwarf signals have bases with slotted holes for mounting bolts. These holes allow the signal to be adjusted horizontally, with the vertical alignment done by manipulating the adjustments as with the mast signal.

The SA-1 signals are available with a wide variety of mast and ladder assemblies, and couplings for flexible conduit or cable.

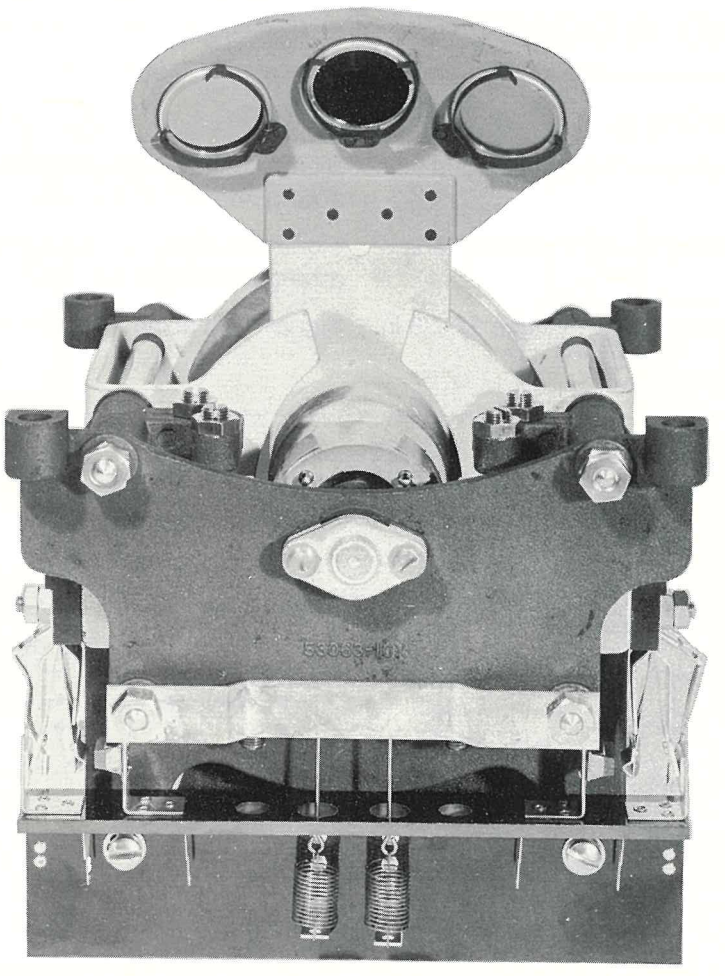


Figure 3. Type SA-1 operating mechanism.

OPERATION

The principles of operation for the Type SA-1 mechanism are illustrated in Figure 4. Polar operation is effected by a permanent magnet, mounted on the spectacle shaft, which polarizes the upper vane north (N) and the lower vane (with counter weight) south (S). The stationary coil, suspended below the spectacle shaft, controls the polarity of pole pieces R and L. With the spectacle shaft assembly isolated from the coil, the possibility of surge currents entering and causing damage to the knife edge bearings is eliminated.

With no energy applied to the coil, the spectacle arm is held in the center (red) position by gravity, due to the counterweight. When energy is applied to the coil, with polarity as shown, pole piece R on the electromagnet is polarized north, and pole piece L is polarized south. As unlike poles attract, the south pole of the permanent magnet (lower vane) is attracted to pole piece R, and the north pole (upper vane) is attracted to pole piece L. As a result, the yellow color disc is positioned in the light beam.

When the polarity of the coil is reversed, the magnetic flux in the core is also reversed. Rotation of the armature in the opposite direction then positions the green color disc in the light beam.

A copper slug on the core of the electromagnet dampens the movement of the spectacle arm when energy is removed from the coil. This electromagnetic damping action, together with the nonbounce characteristics of the mechanical movement, positions each color disc precisely and accurately. This positioning is accomplished without overtravel, which could result in a momentary display of an improper aspect.

Contact position in relation to the polarity of the applied voltage is shown in Figure 5. The contacts are operated by two counterweights which, in turn, are operated through link connections to the rotating spectacle arm.

DIMENSIONS AND WEIGHTS

SIGNAL HOUSING DIMENSIONS

Overall length of signal, including hood — compound lens system: 34 in.

Overall length of signal, including hood — stepped lens system: 29-3/4 in.

Overall height of signal — either optical system: 27-7/8 in.

Lens bezel ring, overall diameter: 10 in.

WEIGHT

Signal housing and signal mechanism — stepped lens arrangement: 140 lbs. total

Signal housing and signal mechanism — compound lens arrangement: 160 lbs. total

Signal mechanism only: 25 lbs.

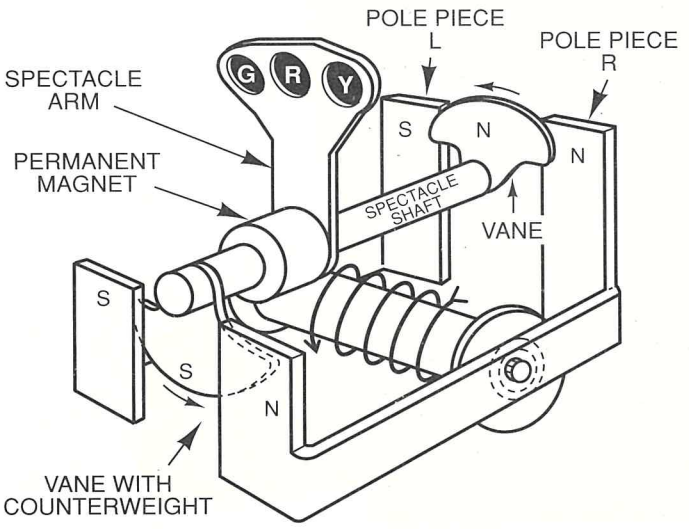


Figure 4. Principles of operation.

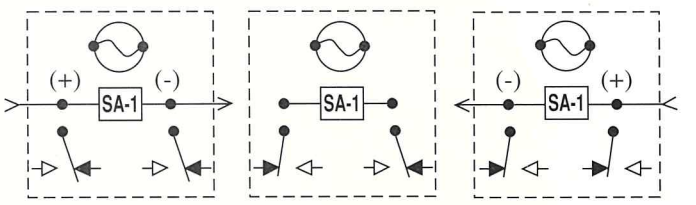


Figure 5. Type SA-1 mechanism contact positions – view facing terminal block.

INSTALLATION

The coupling plate at the bottom of the signal housing requires one of several types of connectors for bringing in conduit or cable. The proper plate and connector, shipped separately from the housing, should be installed prior to mounting.

For most installations, a high signal is positioned, with respect to the track, so that the lens is as near as possible to the eye-level of the engineman and as close to the track as clearances permit. This means the signal usually is mounted on the left side of the mast as viewed by the approaching engineman. Optional brackets permit mounting on the front or on the top of the mast.

Signal housing 1, Figure 6, may be mounted with bracket 2 already attached, or U-bolts 3 of the bracket may be affixed first and the housing then attached. If flexible conduit is used, care must be taken to locate bracket 2 on the mast so it is positioned properly in relation to conduit hole 4. Coarse aiming of the signal housing by sighting over sighting device 5 during mounting will aid in the final beam alignment.

The connection diagram for the Type SA-1 signal is shown in Figure 7. The signal, with a nominal coil resistance of 250 ohms, is designed to operate on 10 volts (5 lead cells or equivalent). The minimum current required for proper operation is 24 ma.

Wires from the plug coupler to the contacts, including the coils wires, are equipped with quick-detachable terminals which require no soldering.

Operating times for the Type SA-1 signal, at 10 volts d-c, are as follows:

Time to close contact from red (deenergized) to yellow (or red to green) . . . . . .0.65 sec.

Time to close red (deenergized) contact from either green or yellow position (time starts when energy is removed) . . . . . .0.58 sec.

Time to close green contact from yellow position (or yellow contact from green position) after energy is pole-changed . . . . . .0.58 sec.

Time yellow to green contact is open (or green to yellow contact is open) during pole change (time that circuit to yellow-green repeater relay is open) . . . . . .0.165 sec.

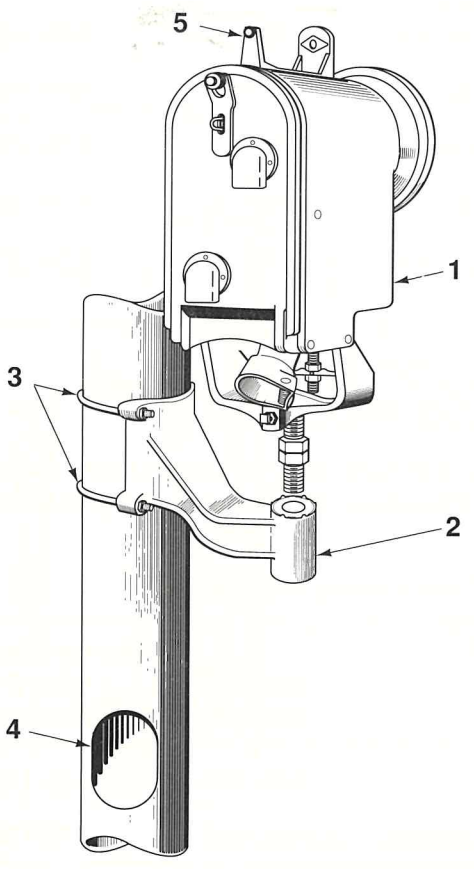


Figure 6. Mounting the Type SA-1 signal on the mast.

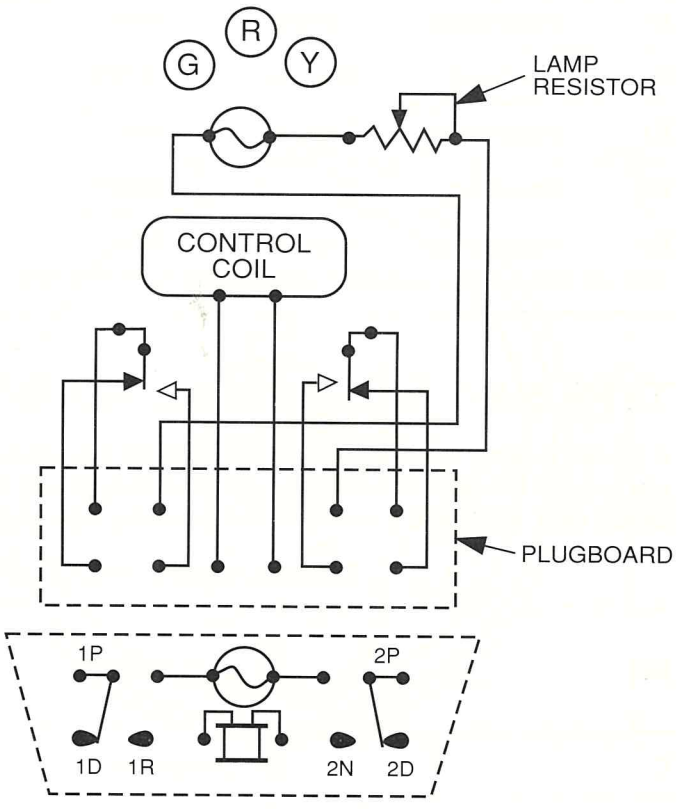


Figure 7. Type SA-1 signal connection diagram – view facing plugboard.

ORDERING INFORMATION

Type SA-1 mast-mounted high signals, listed below, have optical arrangements for tangent track only. They consist of two major assemblies: (1) signal heads complete with choice of mechanism (operating or inoperative), and (2) mast assemblies complete with pinnacle, base, ladder, and platform.

Type SA-1 dwarf signals use one of two mechanisms.

Optional equipment for separate order includes: roundel and Phankill assemblies (page 13), wire entrance couplings and conduit (page 16), ladder support and foundation (page 18), adjustable lamp resistors (page 19), and mast mounting brackets (page 19).

For replacement parts not listed herein, see GRS Parts Catalog, Section 76.

TYPE SA-1 HIGH SIGNAL HEADS COMPLETE WITH MECHANISM

A signal head complete INCLUDES the housing with operating or inoperative mechanism, hood, background, 8-3/8" outer lens for tangent track, ventilators, and bracket for side mounting on a 5" mast (for front and top mounting brackets, see page 19).

A signal head DOES NOT INCLUDE the following; please order separately:

- Wire entrance coupling, see page 16.
- Lamp resistor, see page 19.
- Roundel and Phankill assemblies, see page 13.

To order, specify "SA-1 High Signal" and catalog number.

Ref.	Type of Mechanism	Lens System	Aspect	Type of Wire Connection	Catalog Number With 20" Dia. Background	Catalog Number With 2'-11" Dia. Background
A	Operating	Compound	G/R/Y	Plug coupler	A76-102	A76-114
A1	Inoperative	Compound	Red	A.A.R. terminals	A76-103	A76-115
B	Operating	Stepped	G/R/Y	Plug coupler	A76-106	A76-118
B1	Inoperative	Stepped	Red	A.A.R. terminals	A76-107	A76-119
B2	Operating	Stepped*	G/R/Y	Plug coupler	A76-110	A76-122
B2	Inoperative	Stepped*	Red	A.A.R. terminals	A76-111	A76-123

*FOR USE WITH PHANKILL ASSEMBLY, STEPPED LENS FURNISHED WITH CLEAR CENTER.

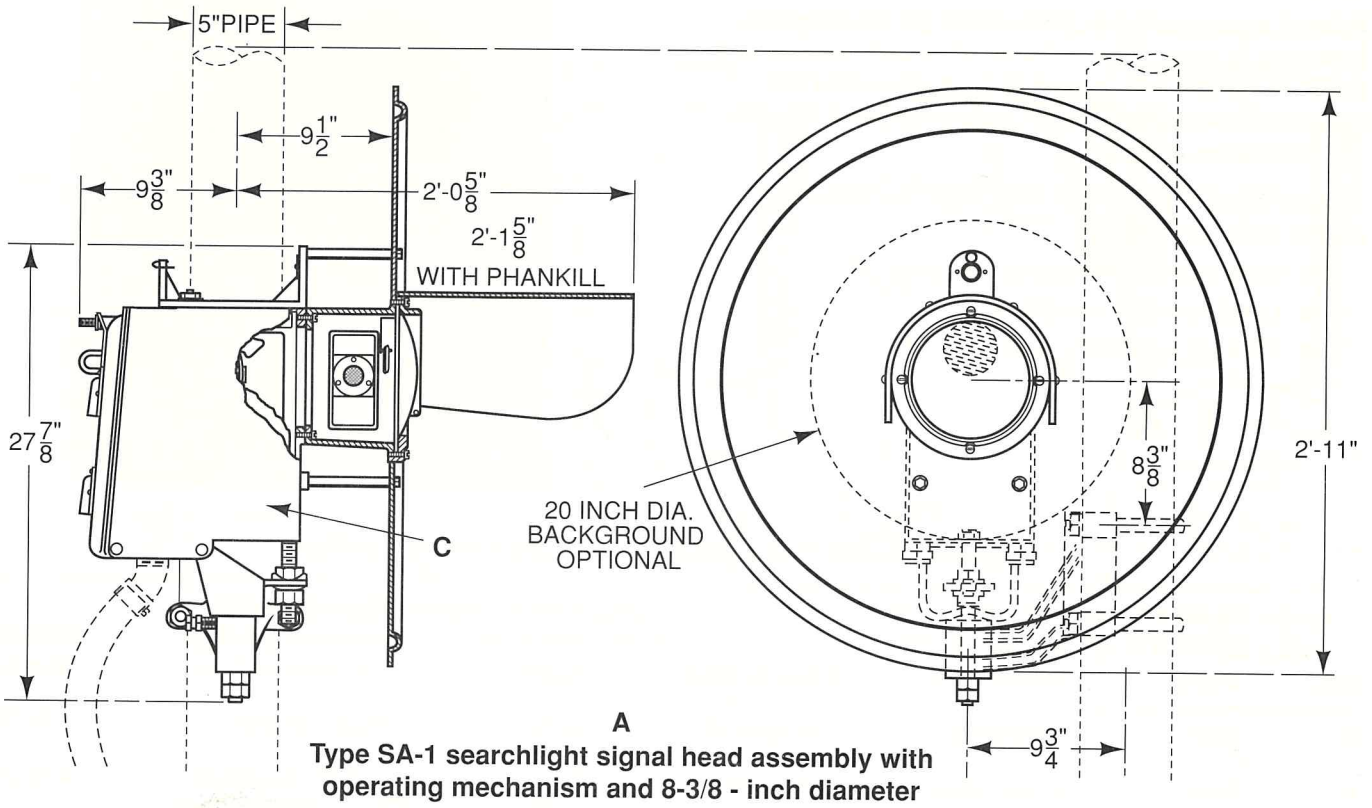
TYPE SA-1 HIGH SIGNAL HOUSING, LESS MECHANISM

A signal housing, less mechanism, INCLUDES a hood, background, 8-3/8" outer lens for tangent track, ventilators, and bracket for side mounting on a 5" mast (for top and front mounting brackets, see page 19). A signal housing DOES NOT INCLUDE a wire entrance coupling (see page 16).

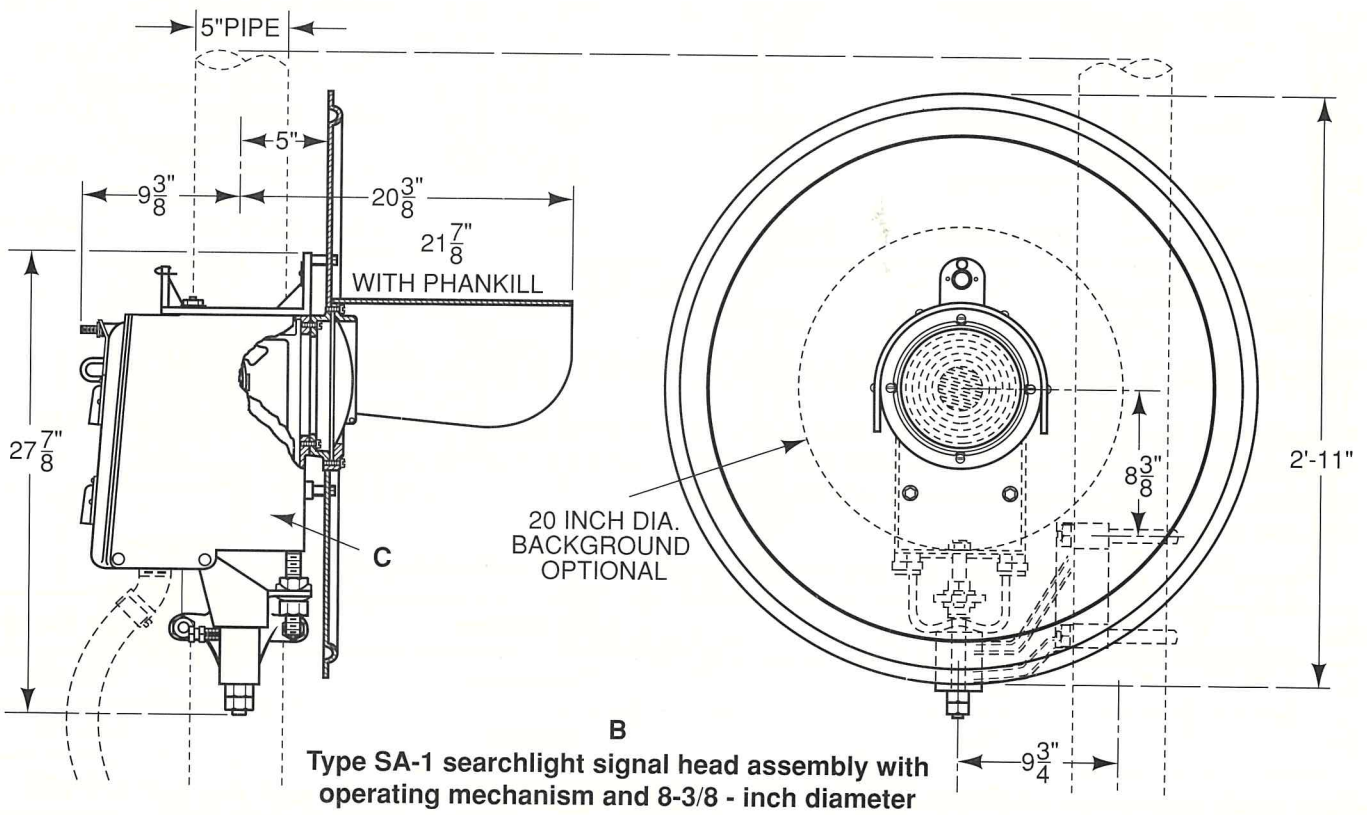
To order, specify "High Signal Housing" and catalog number.

Ref.	Lens System	Catalog Number With 20" Dia. Background	Catalog Number With 2'-11" Dia. Background
C	Compound	A76-130	A76-136
C1	Stepped	A76-132	A76-138
C2	Stepped *	A76-134	A76-140

* FOR USE WITH PHANKILL ASSEMBLY, STEPPED LENS FURNISHED WITH CLEAR CENTER.



A
Type SA-1 searchlight signal head assembly with operating mechanism and 8-3/8 - inch diameter COMPOUND LENS.



B
Type SA-1 searchlight signal head assembly with operating mechanism and 8-3/8 - inch diameter STEPPED LENS.

TYPE SA-1 DWARF SIGNAL COMPLETE WITH MECHANISM

A dwarf signal complete INCLUDES the housing with operating or inoperative mechanism, hood, background, 8-3/8" V-inclined 10° upward deflecting roundel (for optional roundels, see Parts Catalog Sections 73 and 76), ventilators, and base.

A dwarf signal DOES NOT INCLUDE the following; please order separately:

- Wire entrance coupling, see page 16.
- Lamp resistor, see page 19.
- Phankill assembly, see page 13.

To order, specify "SA-1 Dwarf Signal" and catalog number.

Ref.	Number Of Units	Type Of Mechanism	Lens System	Aspect	Type of Wire Connection On Mechanism	Catalog Number
A	One	Operating	Compound	G/R/Y	Plug Coupler	A76-201
A1	One	Inoperative	Compound	Red	A.A.R. Terminals	A76-202
B	One	Operating	Stepped	G/R/Y	Plug Coupler	A76-206
B1	One	Inoperative	Stepped	Red	A.A.R. Terminals	A76-207
C	Two	Operating	Compound	G/R/Y	Plug Coupler	A76-211
C1	Two	Inoperative	Compound	Red	A.A.R. Terminals	A76-212
D	Two	Operating	Stepped	G/R/Y	Plug Coupler	A76-216
D1	Two	Inoperative	Stepped	Red	A.A.R. Terminals	A76-217

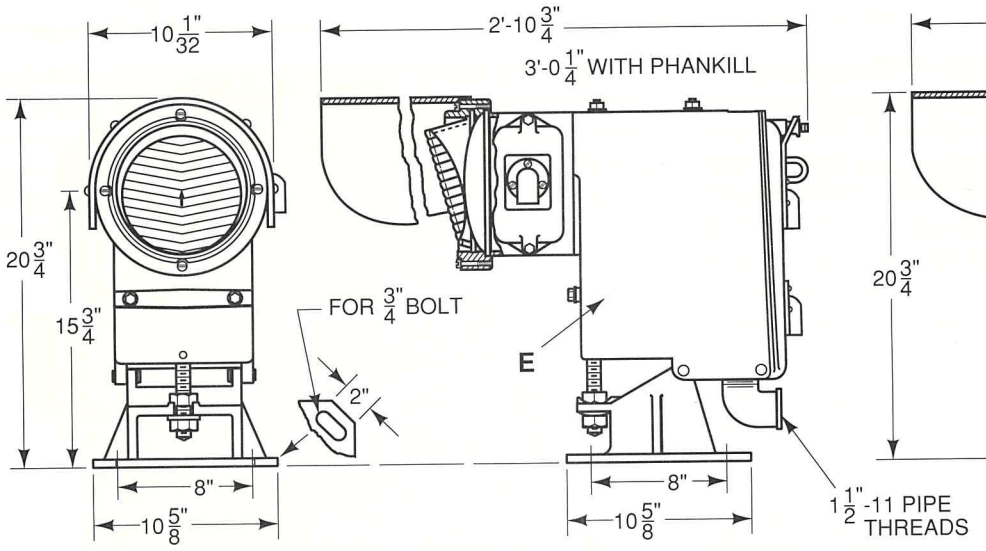
TYPE SA-1 DWARF SIGNAL HOUSING, LESS MECHANISM

A dwarf signal housing, less mechanism, INCLUDES the hood, background, 8-3/8" V-inclined roundel (for optional roundels, see Parts Catalog Sections 73 and 76), ventilators, and base.

A dwarf signal housing DOES NOT INCLUDE a wire entrance coupling (see page 16).

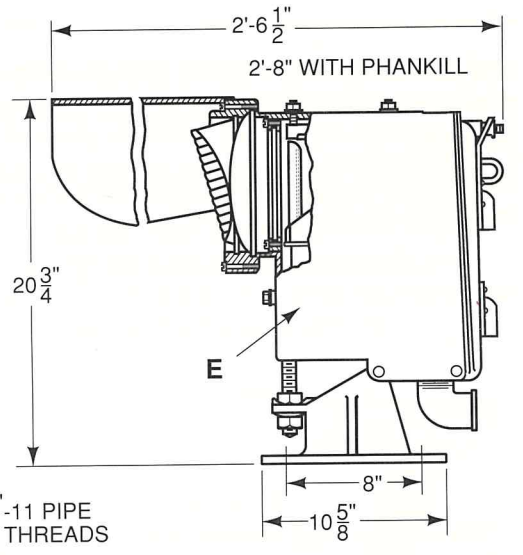
To order, specify "Dwarf Signal Housing" and catalog number.

Ref.	Number of Units	Lens System	Catalog Number
E	One	Compound	A76-220
E1	One	Stepped	A76-221
F	Two	Compound	A76-225
F1	Two	Stepped	A76-226



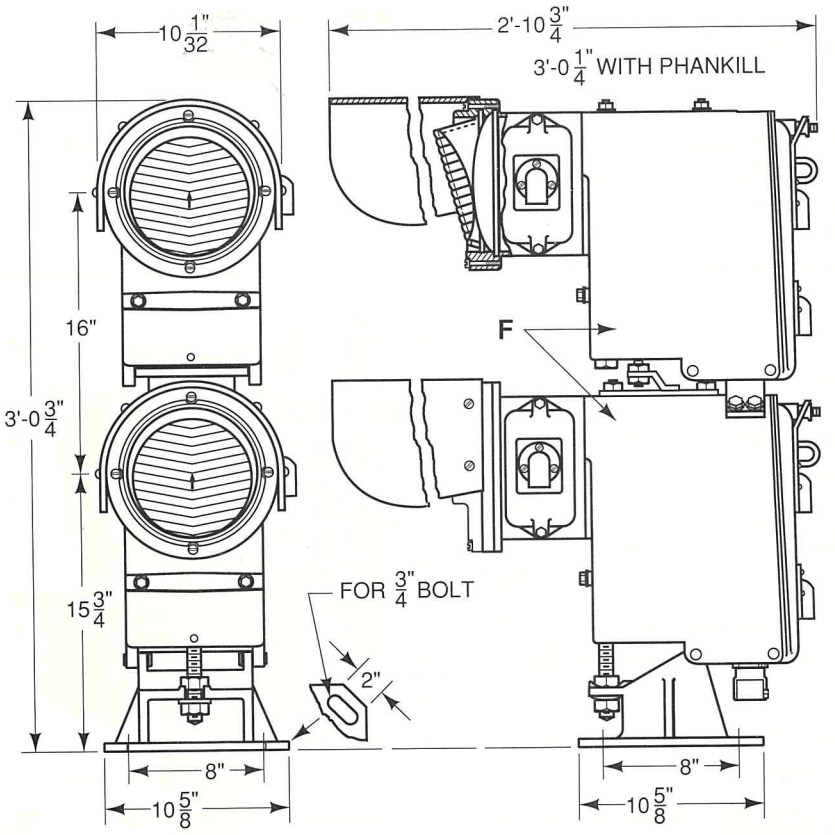
A

Type SA-1 searchlight dwarf signal with 8-3/8 inch dia. COMPOUND LENS.



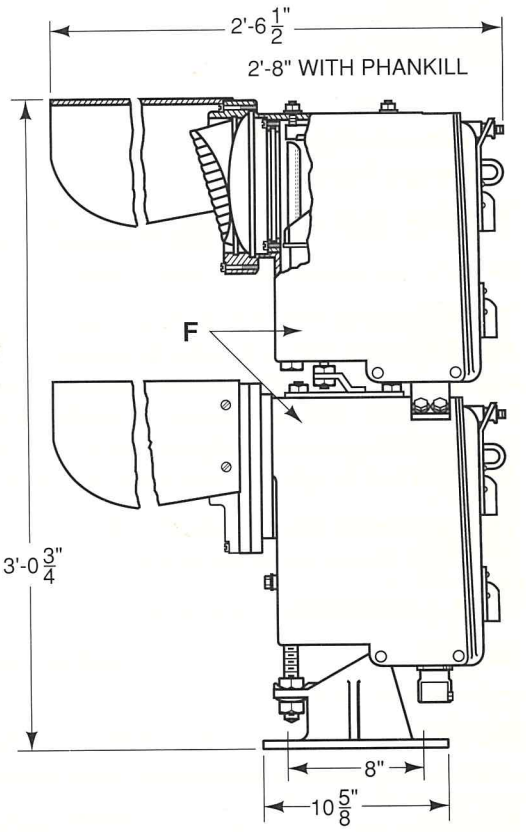
B

Type SA-1 searchlight dwarf signal with 8-3/8 inch dia. STEPPED LENS.



C

Two unit Type SA-1 searchlight dwarf signal with 8-3/8 inch dia. COMPOUND LENS.



D

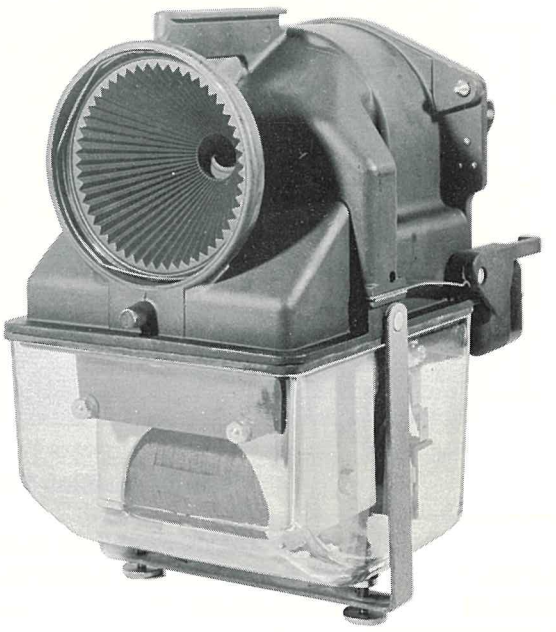
Two unit Type SA-1 searchlight dwarf signal with 8-3/8 inch dia. STEPPED LENS.

TYPE SA-1 SIGNAL OPERATING MECHANISM

The operating mechanism is available with a compound or stepped lens system and has a plug coupler for wire connections.

The operating mechanism DOES NOT INCLUDE the following; please order separately:

- Lamp resistor, see page 19.



To order, specify
"SA-1 Operating Mechanism" and catalog number.

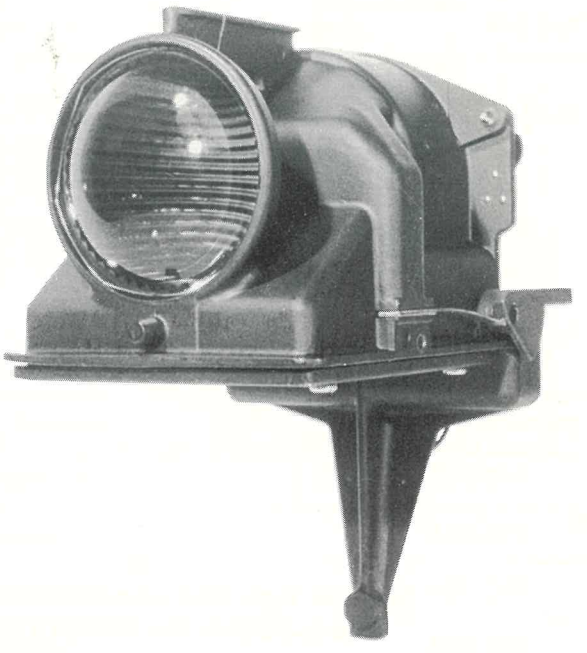
Lens System	Catalog Number
Compound	A76-154
Stepped	A76-157

TYPE SA-1 SIGNAL INOPERATIVE MECHANISM

The inoperative mechanism is for use in two-unit dwarf signals (where only one color is needed) or in high signals that might later be equipped with operating mechanisms. The mechanism is available with a compound or stepped lens system and is provided with standard A.A.R. terminal posts for wire connections.

The inoperative mechanism DOES NOT INCLUDE the following; please order separately:

- Lamp resistor, see page 19.



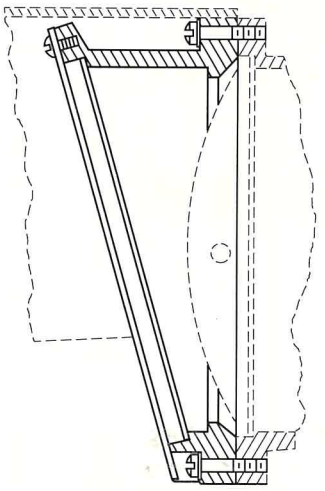
To order, specify
"SA-1 Inoperative Mechanism" and catalog number.

Lens System	Aspect	Catalog Number
Compound	Red	A76-490
Stepped	Red	A76-492

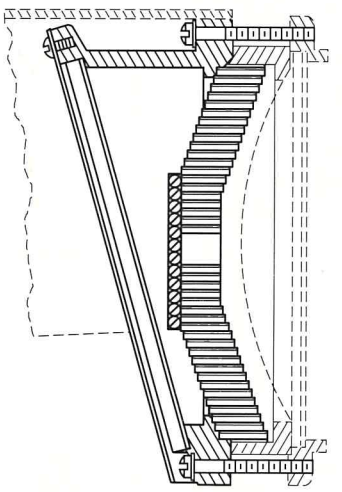
ROUNDEL AND PHANKILL ASSEMBLIES

Signal heads, furnished with 8-3/8" lenses for tangent track only, can be adapted easily for specific conditions by the addition of a roundel or Phankill assembly. The special optical equipment comes ready for installation, except for sealing compound, for which GRS recommends sealing compound per 90B0010.

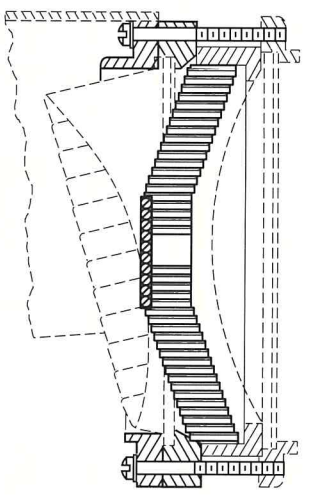
Roundel assemblies fit both stepped and compound lens signals; Phankill assemblies for high signals have a built-in 25 degree close-up roundel. On compound lens high signals, remove the existing close-up roundel before installing the Phankill. A Phankill used with a stepped lens requires a separate order of a signal head with a clear center lens (see page 8), which is specially arranged for use with the Phankill. For other roundels and lenses, see Parts Catalog Sections 73 and 76.



A
Roundel Assembly for high signals.



B
Roundel assembly with Phankill for high signals.



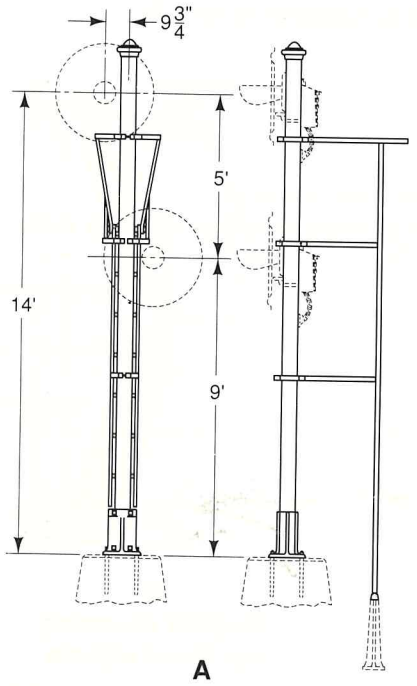
C
Phankill assembly for dwarf signals

To order, specify name shown in bold type and catalog number.

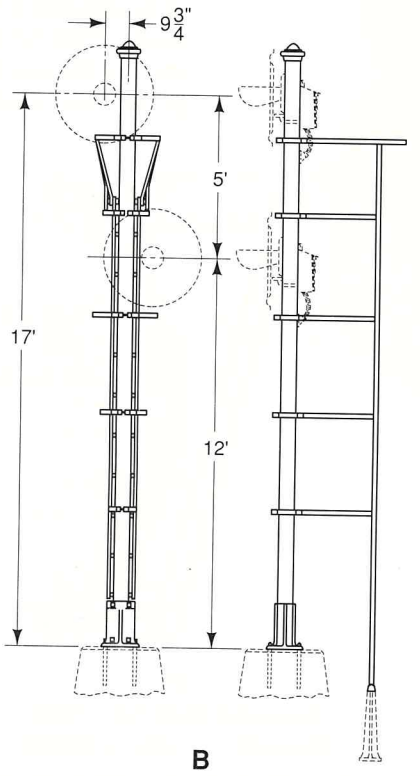
Ref.	Name	Catalog Number
A	**ROUNDEL ASSEMBLY**, inclined 20° deflecting, for compound or stepped-lens high signal	**A76-350**
A1	**ROUNDEL ASSEMBLY**, same as Ref. A, except 30° Spredlite	**A76-353**
B	**PHANKILL ASSEMBLY**, for compound or stepped-lens high signal. The inclined roundel included has no deflecting or Spredlite characteristics	**A76-360**
B1	**PHANKILL ASSEMBLY**, same as Ref. B, except with 20° deflecting roundel	**A76-362**
B2	**PHANKILL ASSEMBLY**, same as Ref. B, except with 30° Spredlite roundel	**A76-363**
C	**PHANKILL ASSEMBLY**, for compound or stepped-lens dwarf signals	**A76-370**

MAST ASSEMBLIES

Masts have 5" inside diameters and are drilled for the number of signal heads listed. Mast heights are approximate. Masts come complete with pinnacle, base, ladder and platform, except for Ref. D that has no ladder and platform.
To order ladder supports or foundations, see page 18.



A



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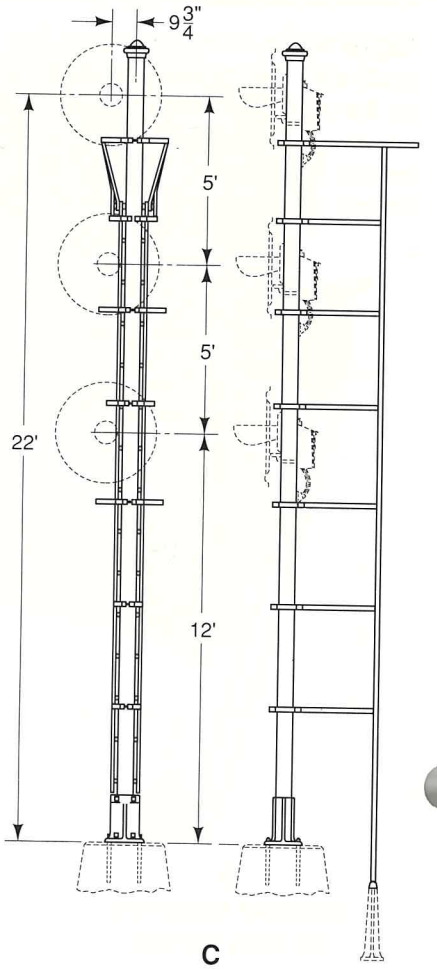

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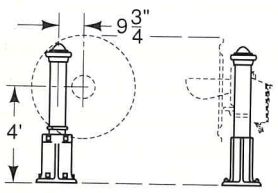

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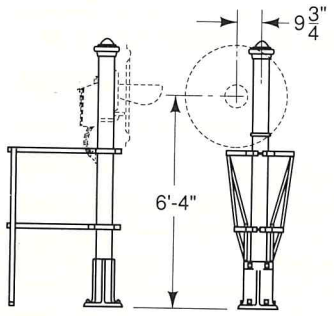

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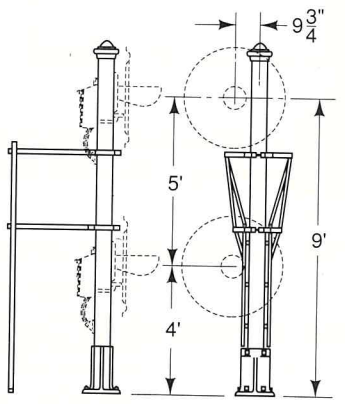

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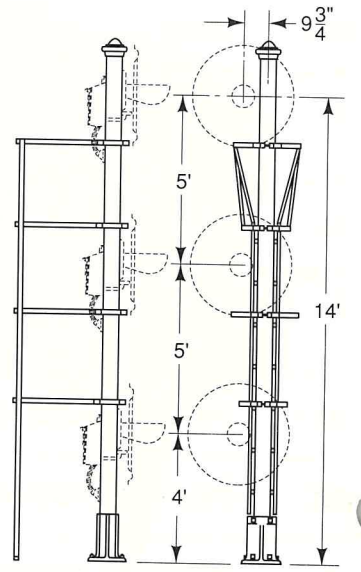

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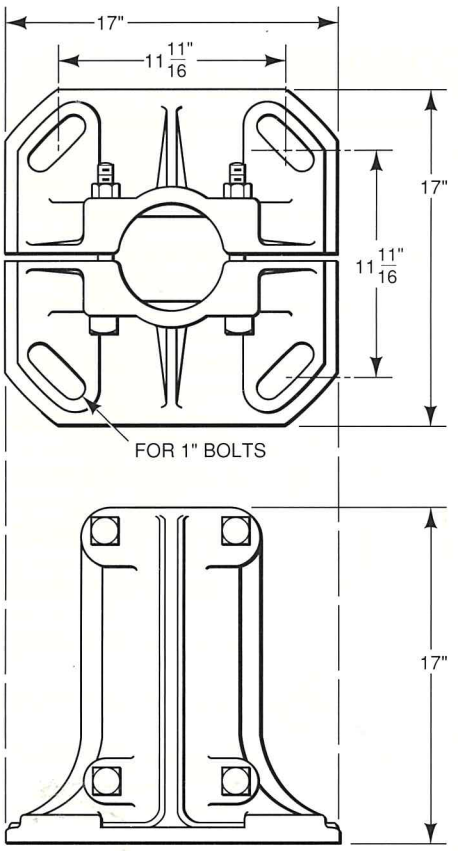
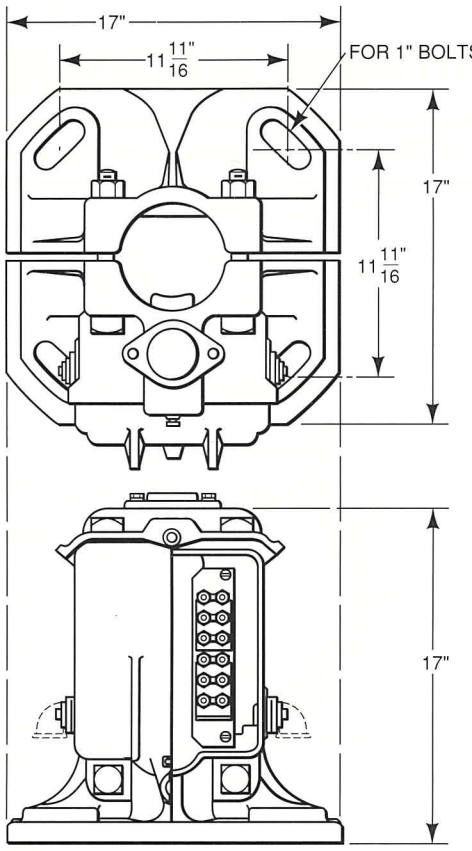


SPLIT BASE



SPLIT JUNCTION BOX BASE

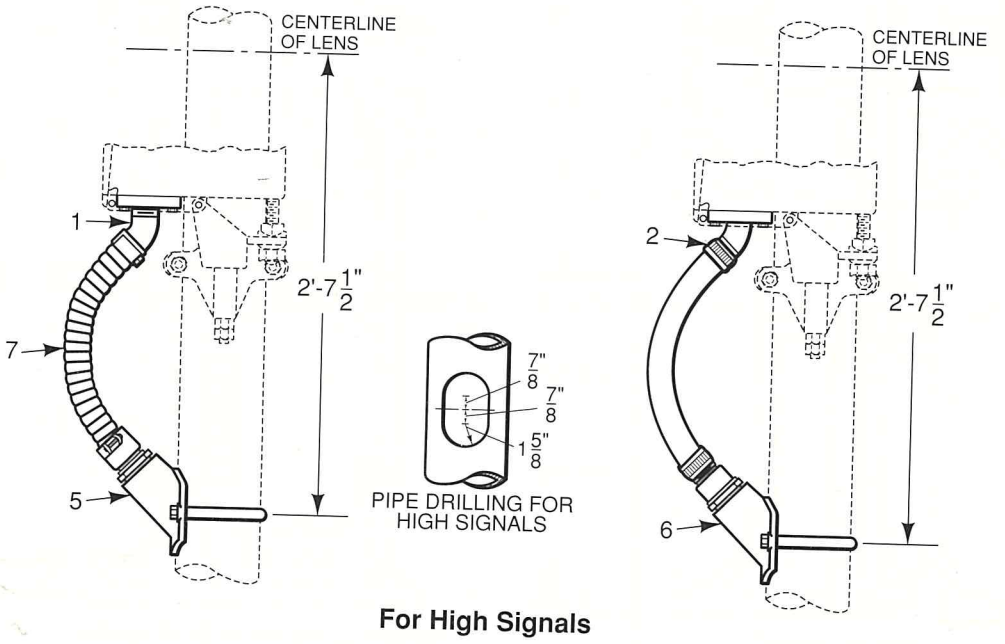
Bases included with signal mast assemblies.

To order, specify "Mast Assembly" and catalog number.

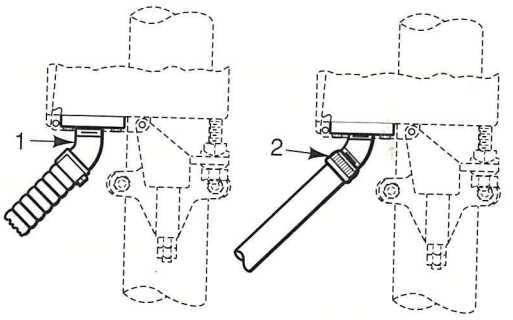
Ref.	Drilled For Signal Heads	Type of Base (See Above)	Catalog Number
A	Two	Split	A76-302
A1	Two	Split junction box	A76-303
B	Two	Split	A76-308
B1	Two	Split junction box	A76-309
C	Three	Split	A76-312
C1	Three	Split junction box	A76-313
D	One	Split	A76-319
		Split junction box	A76-323
E	One	Split	A76-316
		Split junction box	A76-320
F	Two	Split	A76-317
		Split junction box	A76-321
G	Three	Split	A76-318
		Split junction box	A76-322

WIRE ENTRANCE COUPLINGS AND CONDUIT

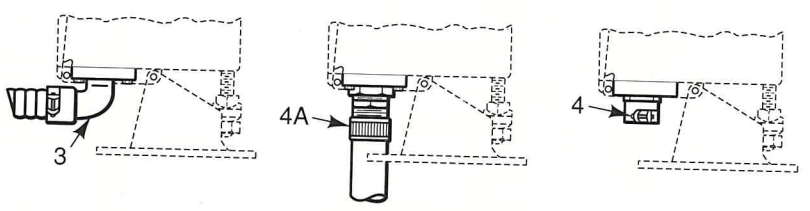
Wire entrance couplings 1, 2, 5 and 6 are for high signal housings;
wire entrance couplings 3 and 4 are for dwarf signal housings.



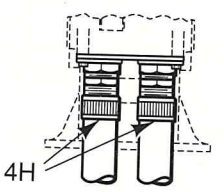
For High Signals



For Bridge and Bracket Post Signals



For All Dwarf Signals

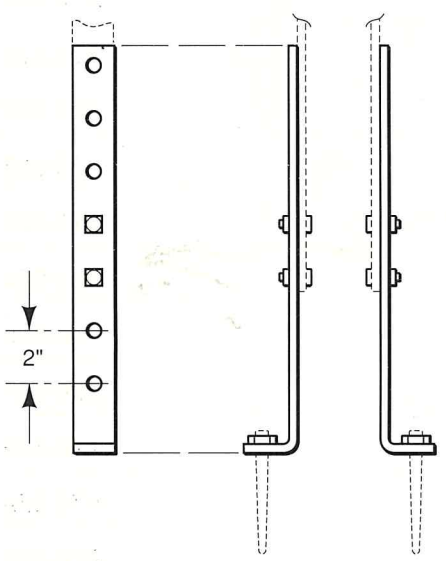


For Two-Unit Dwarf Signal Only

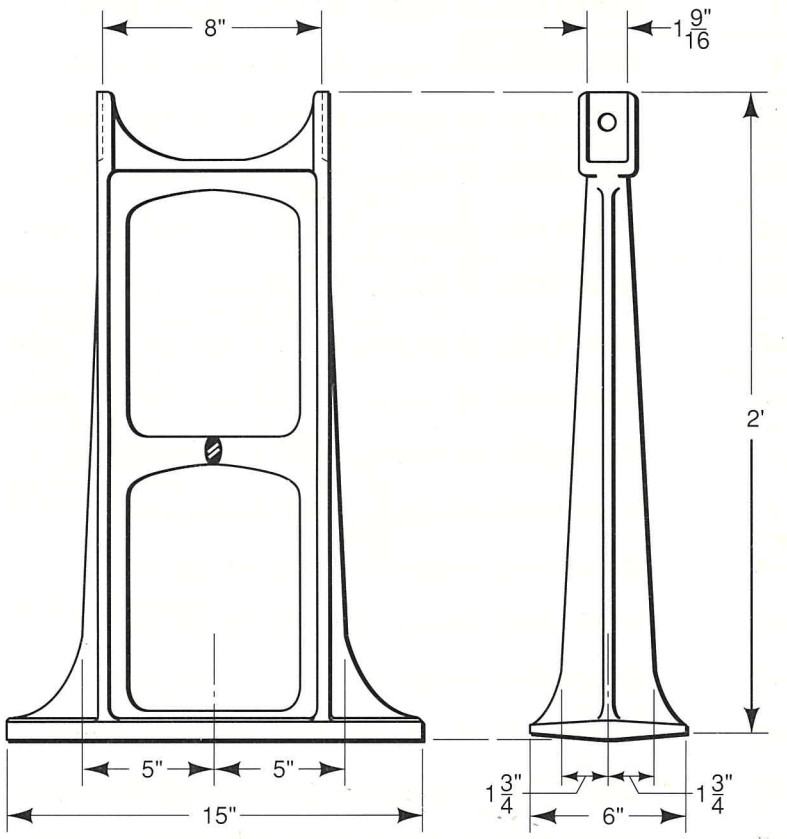
To order, specify name shown in bold type and catalog number.

Ref.	Name	Catalog Number
1	**COUPLING**, 45 degree, for 1-1/2" flexible conduit	A76-526
2	**COUPLING**, 45 degree, for 5/8" to 3/4" dia. cable	A76-527
2A	**COUPLING**, 45 degree, for 3/4" to 7/8" dia. cable	A76-528
2B	**COUPLING**, 45 degree, for 7/8" to 1.0" dia. cable	A76-536
2C	**COUPLING**, 45 degree, for 1.0" to 1-3/16" dia. cable	A76-537
2D	**COUPLING**, 45 degree, for 1-3/16" to 1-3/8" dia. cable	A76-538
2E	**COUPLING**, 45 degree, for 1-3/8" to 1-5/8" dia. cable	A76-539
2F	**COUPLING**, 45 degree, for 1-5/8" to 1-7/8" dia. cable	A76-542
3	**COUPLING**, 90 degree, for 1-1/2" flexible conduit	A76-553
4	**COUPLING**, straight, for 1-1/2" flexible conduit	A76-564
4A	**COUPLING**, straight, for 5/8" to 3/4" dia. cable	P76-354
4B	**COUPLING**, straight, for 3/4" to 7/8" dia. cable	A76-556
4C	**COUPLING**, straight, for 7/8" to 1.0" dia. cable	A76-557
4D	**COUPLING**, straight, for 1.0" to 1-3/16" dia. cable	A76-558
4E	**COUPLING**, straight, for 1-3/16" to 1-3/8" dia. cable	A76-559
4F	**COUPLING**, straight, for 1-3/8" to 1-5/8" dia. cable	A76-562
4G	**COUPLING**, straight, for 1-5/8" to 1-7/8" dia. cable	A76-563
4H	**COUPLING**, straight, for 1-3/16" to 1-3/8" dia. cable for two-unit dwarf signal only	A76-567
5	**COUPLING**, complete with "U" bolt, reducer and gasket for 1-1/2" flexible conduit	A76-568
6	**COUPLING**, complete with "U" bolt, reducer and gasket for 5/8" to 3/4" dia. cable	A76-529
6A	**COUPLING**, same as Ref. 6 for 3/4" to 7/8" dia. cable	A76-530
6B	**COUPLING**, same as Ref. 6 for 7/8" to 1.0" dia. cable	A76-531
6C	**COUPLING**, same as Ref. 6 for 1.0" to 1-3/16" dia. cable	A76-532
6D	**COUPLING**, same as Ref. 6 for 1-3/16" to 1-3/8" dia. cable	A76-533
6E	**COUPLING**, same as Ref. 6 for 1-3/8" to 1-5/8" dia. cable	A76-534
6F	**COUPLING**, same as Ref. 6 for 1-5/8" to 1-7/8" dia. cable	A76-535
7	**CONDUIT**, 1-1/2" flexible, recommended length 2 ft., specify ft. required	A85-868

LADDER SUPPORT AND FOUNDATION



A
Ladder Supports



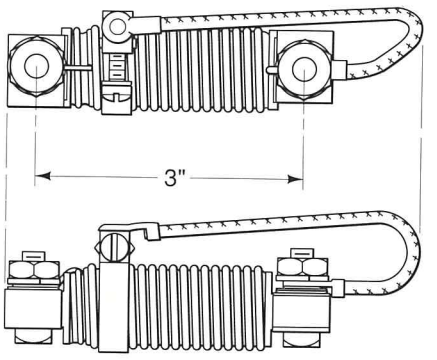
B
Ladder Foundation

To order, specify name shown in bold type and catalog number.

Ref.	Name	Catalog Number
A	**SUPPORT**, adjustable for use when ladder is to be fastened directly to flat surface; order includes bolts and nuts for attaching to ladder	**A76-325**
B	**FOUNDATION**, for ladder; includes bolts and nuts	**A76-327**

ADJUSTABLE LAMP RESISTORS

An adjustable lamp resistor is required for each Type SA-1 operating or inoperative signal mechanism. The resistor must match the lamp used.

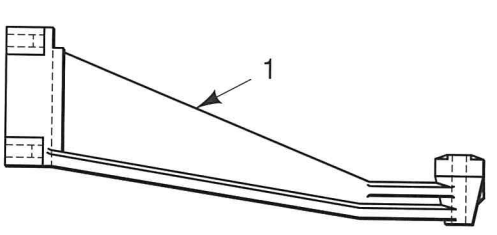


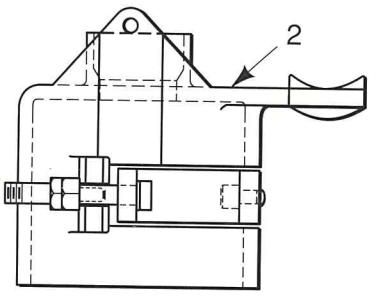
To order, specify "Lamp Resistor" and catalog number.

Nominal Resistance, Ohms	Maximum Current	Catalog Number
1	2.5 amps	A76-330
2	1.75 amps	A76-331
5	1.0 amp	A76-332

OPTIONAL MAST MOUNTING BRACKETS

Replaces Side Of Mast Bracket





To order, specify name and catalog number.

Ref.	Name	Catalog Number
1	Mounting Bracket, Front of Mast	P76-412
2	Mounting Bracket, Top of Mast	P76-540

GENERAL RAILWAY SIGNAL
A UNIT OF GENERAL SIGNAL

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PO BOX 20600 ROCHESTER NY 14602-0600 Phone: 716 • 783-2000 Cable: GENRASIG (ROCHESTER NY) Telex: 978317

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Cable: GENRASIG (ROCHESTER NY) Telex: 978317

GEC-GENERAL SIGNAL LIMITED
BOREHAMWOOD INDUSTRIAL PARK ROWLEY LANE BOREHAMWOOD HERTFORDSHIRE WD6 5PZ ENGLAND
Phone: 44-1-953-9922 Cable: RAILSIGKO BOREHAMWOOD (ENGLAND) Telex: 851-916129 GEC GS

ALGEMENE SEIN INDUSTRIE B.V.
CROESELAAN 28 3521 CB UTRECHT NETHERLANDS Phone: 31-30-94-26-46
Cable: GENRASIG UTRECHT (NETHERLANDS) Telex: 844-47455 GRASI NL

CASCO SIGNAL LIMITED
1150 QIU JIANG ROAD ZHA BEI DISTRICT SHANGHAI PEOPLES REPUBLIC OF CHINA Phone: 86-21-63-7080

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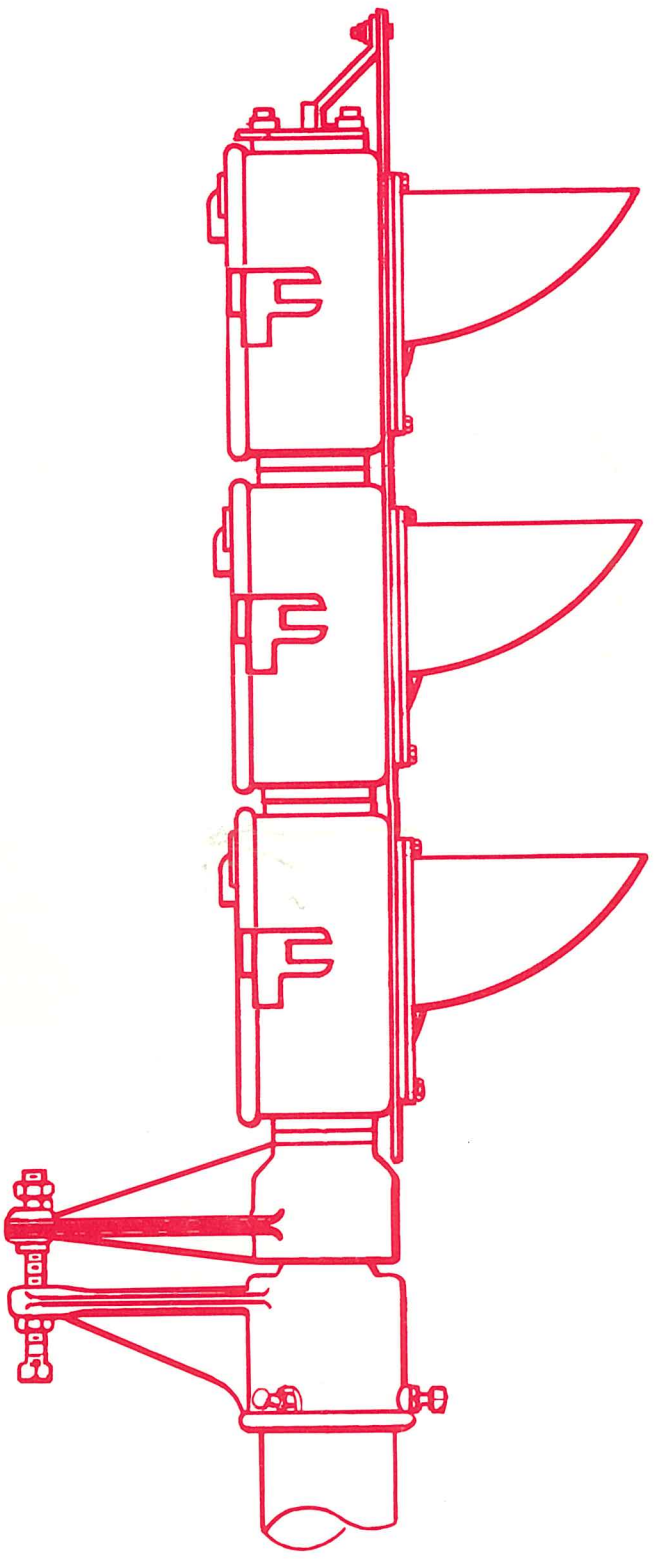
COLOR LIGHTS

COLOR-LIGHT SIGNALS

GRS CATALOG **73-1**



CONTENTS

	Page
INTRODUCTION	4
Optical Arrangements	4
Lamps	4
Alignment	4
TYPES D1 AND G1 COLOR-LIGHT HIGH SIGNALS	5
TYPES FA, MD, ME, AND MF COLOR-LIGHT DWARF SIGNALS	6
TYPE P COLOR-LIGHT SWITCH POSITION SIGNAL	7
TYPE U COLOR-POSITION-LIGHT HIGH SIGNAL	7
TYPE VA COLOR-POSITION-LIGHT DWARF SIGNAL	7
TYPE W MARKER SIGNAL	8
TYPES AT AND AW COLOR-LIGHT SIGNALS	8
ORDERING REFERENCES	9

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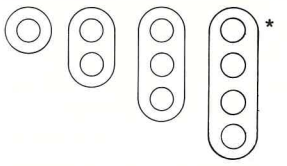
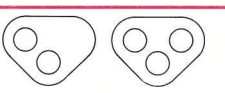
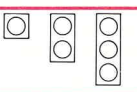
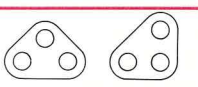
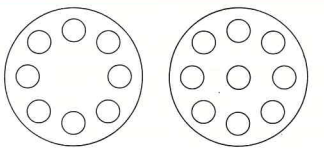
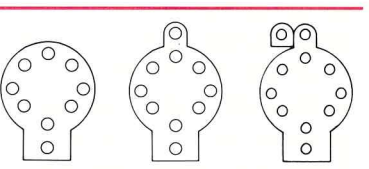
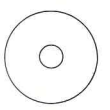
COLOR-LIGHT AND COLOR-POSITION-LIGHT SIGNALS

DESIGNATION	DESCRIPTION	SIZE OF OUTER LENS OR ROUNDEL	NUMBER OF ASPECTS
Type D and D1 High	Long range color light, unit construction.	8-3/8"	 *
Type G and G1 High	Long range color-light, triangular assembly	8-3/8"	
Type FA Dwarf	Short range color-light, cast aluminum, unit construction	6-3/8"	
Type MD Dwarf	Short range color-light, cast aluminum, space for relay and transformer	6-3/8"	
Type ME Dwarf	Short range color-light, cast aluminum, for minimum clearance areas	6-3/8"	
Type MF Dwarf	Short range color-light, cast aluminum,	6-3/8"	
Type P Dwarf	Short range color-light, cast aluminum for switch position indication	5-3/8"	Side 1 Side 2
Type U High	Long range color-position-light, aluminum, circular assembly, 8 or 9 light unit construction	8-3/8"	
Type VA Dwarf	Short range color-position-light, cast aluminum, circular assembly	4"	
Type W High	Long range color-light marker, cast steel, single lens	8-3/8"	
Type AT	Short range color-light, unit construction; for rapid transit, indoors	5"	
Type AW	Short range color-light, unit construction; for rapid transit, outdoors	6-3/8"	

* Four aspect available in Type D only

INTRODUCTION

GRS color-light and color-position-light signals provide various indications by the display of one or more colored aspects. These signals are rugged, compact, simply designed units that meet all operating needs and provide ideal, dependable aspects in all service conditions. The major features are:

1. No moving parts for maximum life and minimal maintenance.
2. Compact construction to fit minimum clearance areas.
3. Factory-focused lamp assemblies with GRS precision filament lamps—no refocusing needed when replaced.
4. Optical arrangements for tangent tracks.
5. Easily added Phankills to reduce beam dilution, Anti-Phans to reduce phantom indications, and roundels for adaptation to curved track.
6. Adjustable lamp resistors.
7. Peep sights or slotted base bolt holes to permit proper alignment.
8. Precision-machined cases to ensure accurate alignment of multiple-unit assemblies.
9. Glass, plastic or polycarbonate lenses.

Optical Arrangements

All signals, except Type P switch signals, are furnished with optical arrangements for tangent tracks.

Color-light signals are almost universally equipped with a doublet lens combination—an outer lens and an inner lens. The outer lens is of stepped construction, and is clear, with deflecting prisms in the hotspot for a close-up indication. The outer surface of the lens is convex and smooth, the steps lying in the concave side. The inner lens is also stepped, but is termed "inverted" because the concave surface is smooth, and the steps lie on the convex side. The inner lens is colored as required for the indication to be displayed.

An outer and inner lens mounted together in a doublet lens combination is more efficient optically than a single lens. This efficiency is due to the short focus of the combination so that more light rays are picked up from the lamp filament. The lenses are assembled with the steps facing each other in a closed compartment, thus exposing only the smooth surfaces to the elements.

The doublet lens combination may be replaced as a unit, or either lens may be replaced separately. However, as these lens combinations are factory focused, care must be taken in reassembling, as the efficiency of the signal may be impaired if assembled improperly. If the outer lens is replaced, sealing compound must be applied to the rim of the lens bezel ring before reassembly. For this GRS recommends Sealing Compound 90B0010.

Optional accessories to adapt the light beams to specific conditions include roundel and Phankill assemblies, and Anti-Phan. An outer deflecting or Spredlite roundel installed in front of the lens adapts a doublet lens to curved track. The assembly includes an additional bezel ring to hold the roundel in position.

The Phankill, which reduces beam dilution in dwarf signals, is a circular metal disc shaped like a diverging concavo-convex lens. It has many small triangular passages through which the signal's beam passes easily, but external light must be within 8° of the beam's axis to pass through the tube-like passages. The Phankill is mounted by a bezel ring in front of the outer lens.

The Anti-Phan, which reduces the intensity of phantom indications in high signals, marker lights, and two-directional signals, consists of a circular piece of fine, black-oxidized, brass wire cloth with many tiny openings. External light reflected by the signal must travel through the Anti-Phan mesh going in and coming out, with the mesh diffusing and weakening it. The Anti-Phan is fastened over the corrugated surface of the inner lens by the signal's regular lens bezel ring.

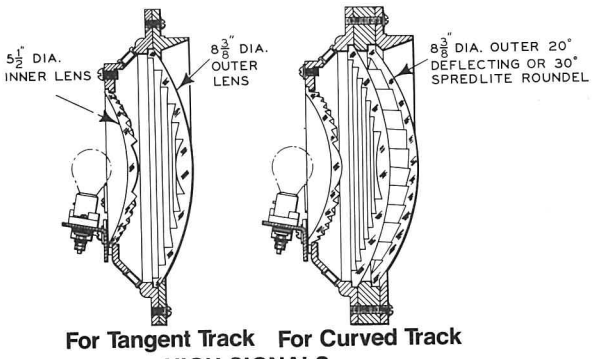
Lamps

GRS precision filament lamps provide consistent, ideal aspects. They are single-contact, candelabra, 2-pin bayonet base lamps that can be replaced in their factory-focused assemblies without refocusing. Signals can be furnished with a two-ohm adjustable lamp resistor (maximum current of 1.75 amperes) in the common return.

Alignment

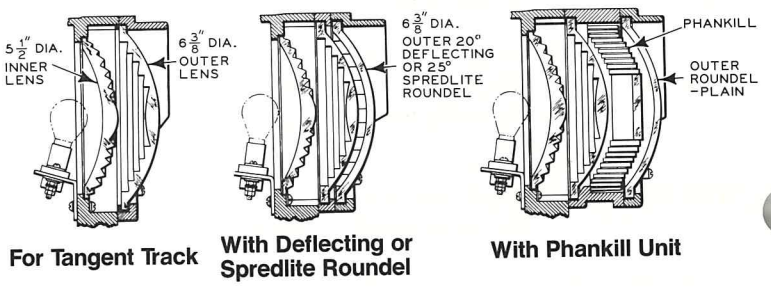
A high signal is aligned by adjusting its support bracket. A peep sight permits proper alignment of the beam with the line of vision of the locomotive engineer.

The base of a dwarf signal is constructed so that, when mounted on a level foundation, the front of the signal is tilted back at the top to direct the light beam up to the engineer's eye level. Slotted bolt holes in the base allow the signals to be pivoted for accurate horizontal alignment.



For Tangent Track **For Curved Track**

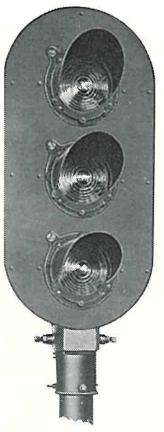
HIGH SIGNALS



For Tangent Track **With Deflecting or Spredlite Roundel** **With Phankill Unit**

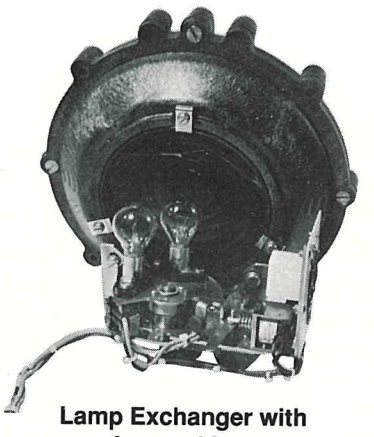
DWARF SIGNALS

TYPES D, D1, G, AND G1 COLOR-LIGHT HIGH SIGNALS



Type D and D1 three aspect color-light signal.

Type G and G1 three aspect color-light signal.



Lamp Exchanger with prefocused lenses.

Types D, D1, G, and G1 long-range color-light signals consist of one or more light units. The D light units are cast aluminum and the D1 light units are molded of rugged structural foam polycarbonate that makes them lightweight, impact-resistant, and weather-resistant. Multiple aspects are obtained by stacking two, three, or four light units (the four aspect signal is available in aluminum only). Single light unit signals often are used as marker lights, take-siding indicators, etc. Multiple aspects for the Type G1 signals are obtained by assembling two or three light units in a triangular arrangement which differs from the single case of the Type G. Each signal has an integral sighting device. Both types of signals have backgrounds, hoods, and pole mounting brackets.

The doublet lens combination in each unit produces a one-color aspect. The 8-3/8" outer lens has a 4" focus and a 40-degree-from-the-horizontal downward deflecting bullseye (or hotspot) lens for close-up indication. The 5-1/2" inner plastic lens is colored to provide a selection of aspects as shown below.

GRS's Lamp Exchanger is available for existing aluminum or ferrous Type D and polycarbonate Types D1 and G1 signals (see page 14). Types D, D1, and G1 signal units may be ordered with the lamp exchanger factory installed.

The lamp exchanger replaces a failed primary lamp with an identical secondary lamp in less than a second. A burned out primary lamp is sensed by an electronic circuit, causing the secondary lamp to be moved to the exact focal position previously occupied by the primary lamp. Long-life lamps of 10, 18, or 25 watts are available. The lamp exchanger operates compatibly with 8 to 11 volts a-c or d-c power in existing or new signal units and is mounted with two screws (or four screws when a lens ring is supplied). A terminal strip is provided for field connections. The lamp exchanger is compatible with existing light-out circuits. Connections are provided for remote sensing that full indexing has occurred.

TYPES D AND D1 SIGNAL ASPECTS

FOUR ASPECT*	THREE ASPECT	TWO ASPECT	ONE ASPECT
Upper—green	Upper—green or red	Upper—yellow	Red
Upper center—yellow	Center—yellow	Lower—red	
Lower center—red	Lower—red or green		
Lower—lunar white			

TYPES G AND G1 SIGNAL ASPECTS

THREE ASPECT	TWO ASPECT	TWO ASPECT	TWO ASPECT
Upper left—green	Upper right—yellow	Upper left—green	Upper left—green
Upper right—yellow	Lower—red	Lower—red	Lower—yellow
Lower—red			

* Four aspect available in Type D only

TYPES FA, MD, ME, AND MF COLOR-LIGHT DWARF SIGNALS

Types FA, MD, ME, and MF color-light dwarf signals have doublet lens combinations and optical arrangements for tangent track. Separately ordered roundels and Phankills may be added in front of the lens to adapt these compact signals to curved track. Each signal is housed in a cast aluminum case having an aluminum hood, both painted black.

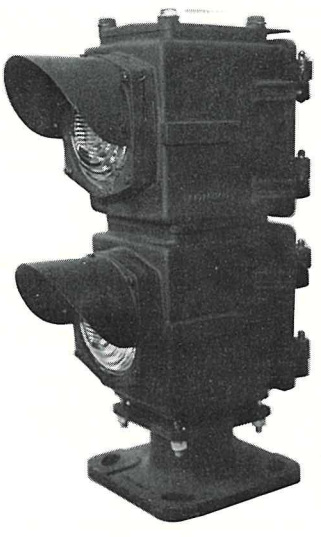
The doublet lens combination in each signal has a 6-3/8" clear outer plastic lens with a 3-3/4" focus and a 40-degree-from-the-horizontal upward deflecting bullseye in the center for close-up indications. The 5-1/2" inner plastic lens is available in red, yellow, green, lunar white, and clear.

The Type FA signal is of unit construction to permit multiple signals to be bolted together, one atop the other. It usually is used in assemblies of three units to obtain green, yellow, and red aspects. Bolt holes in the base are slotted to permit the signal to be pivoted for accurate alignment. Three pole-mounting sockets are available to mount Type FA signals on 2-1/2", 3", or 4" I.D. pipe. Space is provided in each signal assembly for a Type K1/2 transformer.

The Types MD and ME signals provide two indications, yellow and red, or green and red. One of the bolt holes in the base is slotted to permit the signal to be pivoted for accurate alignment. The Type MD signal case has space for a control relay, transformer, etc; such equipment for the Type ME signal must be housed separately.

Type MF signal.

The Type MF signal has a triangular case, designed for mounting in a limited space. It has three aspects — red, yellow and green. The base provides a 2-1/2 degree upward tilt to the light beams; additional tilt either backward or forward, is provided by adjusting screws in the base. One of the bolt holes in the base is slotted to permit the signal to be pivoted for accurate alignment. A separate housing is required for control relays and a transformer.



Type FA signal.

Type MD signal.

Type ME signal.

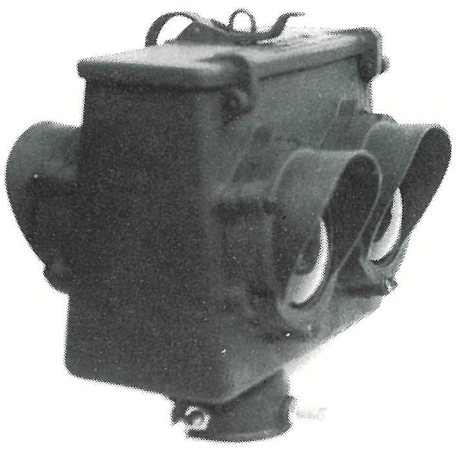
TYPE P COLOR-LIGHT SWITCH POSITION SIGNAL

TYPE U COLOR-POSITION-LIGHT HIGH SIGNAL

TYPE VA COLOR-POSITION-LIGHT DWARF SIGNAL

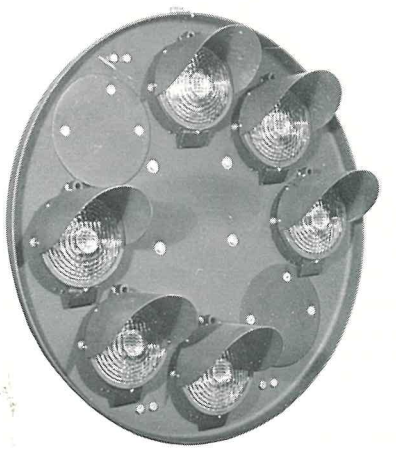
The Type P color-light switch position signal gives two indications in two directions and is designed primarily for use in classification yards at power switch locations. It is housed in a cast aluminum case, painted black.

The doublet lens combination has a 5-3/8" inverted plastic inner lens with a 5-3/8" outer colored glass roundel that provides a 20 degree upward deflection and 18 degree horizontal spread for the most ideal indications. The signal is available with one of three aspect combinations in both directions: red and green, yellow and lunar white, or yellow and green.



The Type U long range color-position-light signal provides indications by the color and positions of the eight light units mounted along the edge of its rigid circular background. It is usually bracket-mounted on a pole or bridge and operates in conjunction with clear or colored marker lights mounted above and/or below it or staggered to either side.

The signal has aluminum light units, background, hoods, and junction box. The 8-3/8" outer plastic lens has a 4" focus and a 40-degree-from-the-horizontal deflecting bullseye. The 5-1/2" inner plastic lens is colored red, yellow, green, or lunar white. The eight light units are arranged in one of 11 combinations to provide the desired indication.



The Type VA color-position-light dwarf signal is a compact eight-indication unit that is available with optional clear indication marker lights. The signal consists of an assembly of three cast aluminum cases — the bottom case houses a maximum of eight signal units, and optional top cases house one or two marker lens units.

The Type VA dwarf signal provides the same indications as the Type U high signal, but its aspects are smaller because it is provided with 4" lenses and 20° upward deflecting roundels. The inner lens is glass; the outer lens and roundel are polycarbonate.

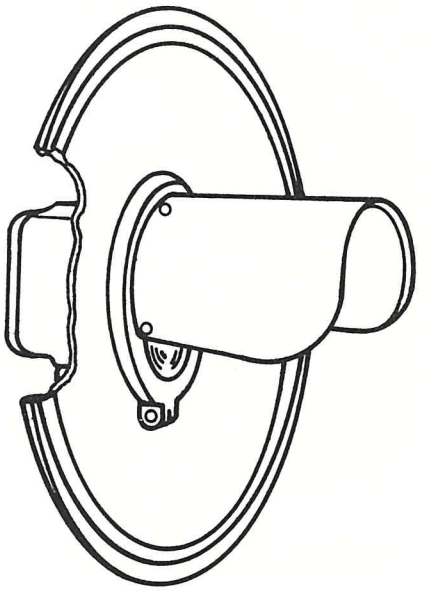
TYPE W MARKER SIGNAL

TYPES AT AND AW COLOR-LIGHT SIGNALS

The Type W marker signal usually is used in a vertical or staggered arrangement with a searchlight signal or position-light signal and can be mounted on the same standard 5" pole. The housing is cast iron with a cast aluminum bezel ring.

The signal is offered with a choice of either a reflector-type or doublet lens optical arrangement, both of which are for tangent track and not adaptable for use with Spredlite or deflecting roundels. The reflector type signal has an 8-3/8" red plastic roundel. The doublet lens signal has a 5-1/2" red inner plastic lens and an 8-3/8" outer plastic lens, with a 40-degree close-up deflector as part of the outer lens.

A universal mounting clamp permits the positioning of the signal either in front of a pole or 9" to the right or left of the pole. A separate housing is required for control relays and a transformer.

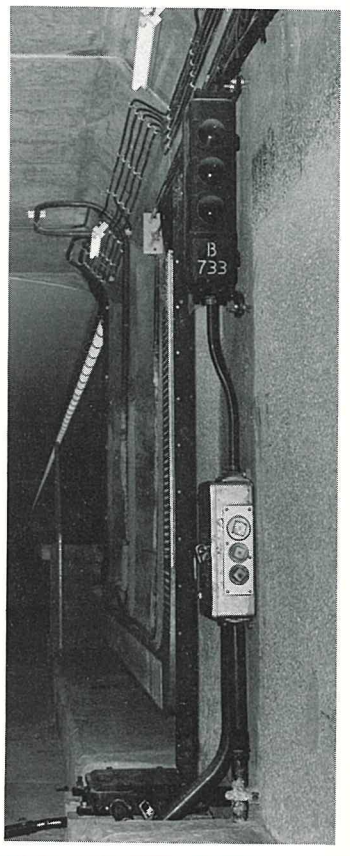


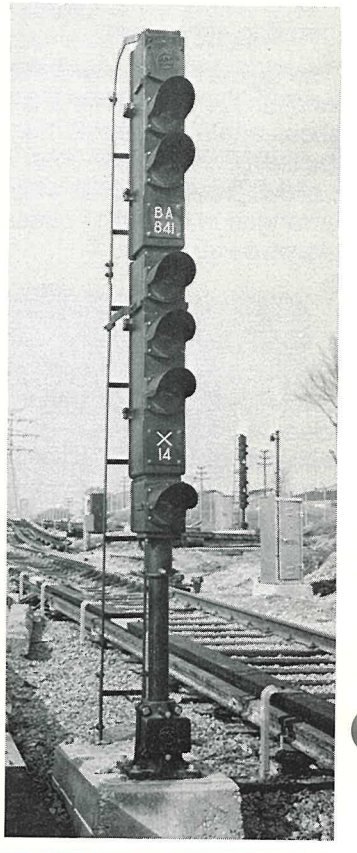
Types AT and AW color-light signals are compact units designed for rapid transit lines where clearances are very limited.

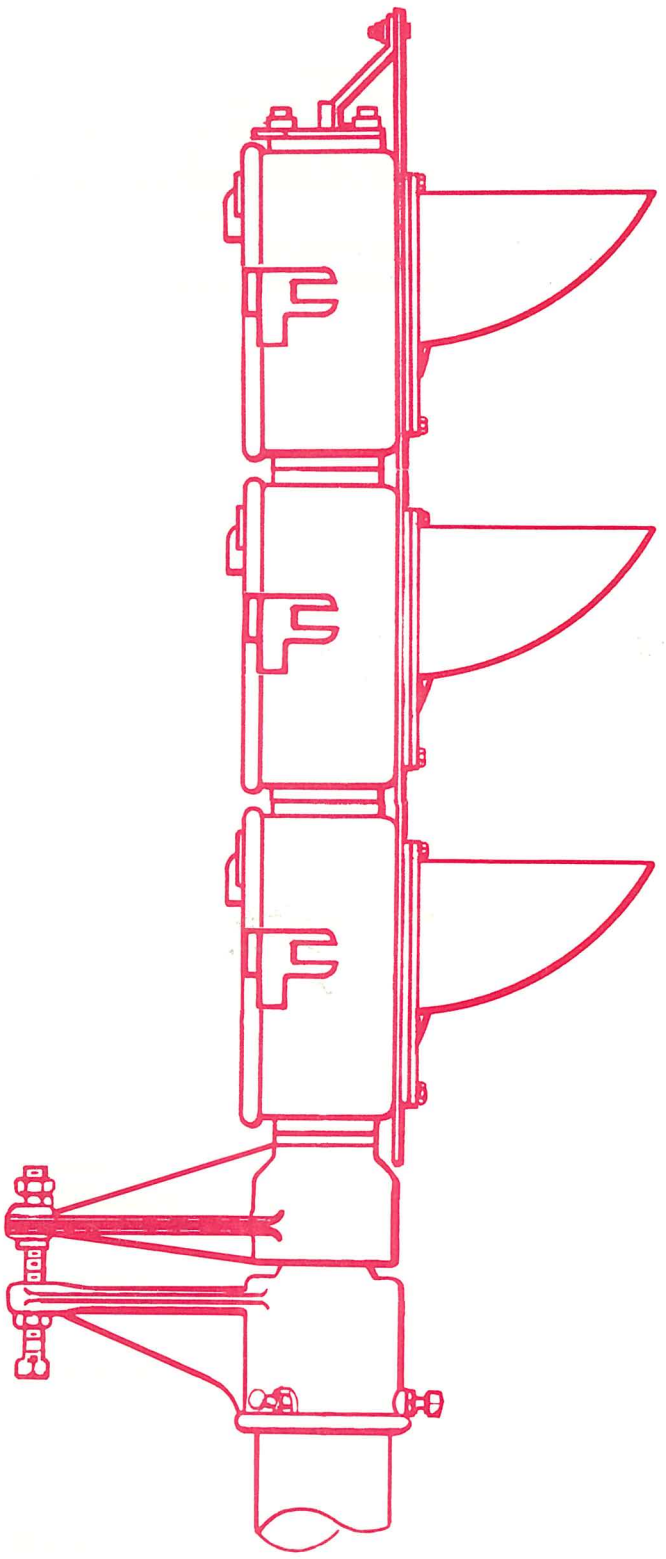
The Type AT signal, for use in underground locations, has a single optical lens since the efficiency of a doublet lens is not required in the darkness. The 5" glass lens has a 3-1/2" focus and is available in red, yellow, green, lunar white, and clear.

The Type AW signal, for use in outdoor locations, uses a doublet lens combination. The 6-3/8" clear outer plastic lens has a 3-3/4" focus and a 40-degree from-the-horizontal deflecting bulls-eye in the center for close up indications. The 5-1/2" inner plastic lens is available in red, yellow, green, lunar white, and clear.

Types AT and AW signals are of unit construction to permit multiple units to be bolted together, one atop the other. Type AT signals are usually provided with brackets for mounting on the subway wall or ceiling. Type AW signals are usually provided with pole mounting sockets.







ORDERING REFERENCES

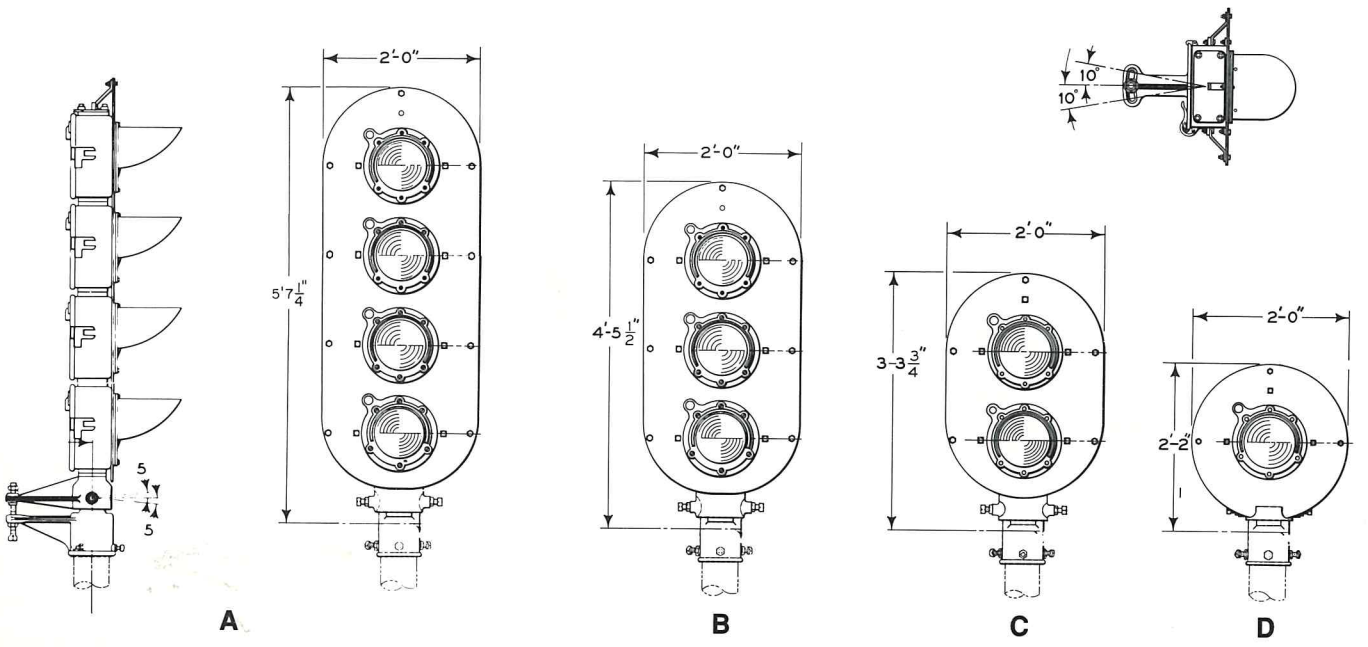
	Page
TYPES D AND D1 HIGH SIGNAL HEADS	10
TYPES G AND G1 HIGH SIGNAL HEADS	11
Pole and Ladder Assemblies	12
Ladder Support and Foundation	13
Roundel Assemblies and Anti-Phan	14
Lamp Exchanger	14
Mounting Brackets, Conduit, and Couplings	15
TYPE FA DWARF SIGNAL	17
TYPE MD DWARF SIGNAL	18
TYPE ME DWARF SIGNAL	19
TYPE MF DWARF SIGNAL	20
TYPE P COLOR-LIGHT SIGNAL	21
TYPE U COLOR-POSITION-LIGHT HIGH SIGNAL	23
TYPE VA COLOR-POSITION-LIGHT DWARF SIGNAL	25
TYPE W MARKER SIGNAL	27

NOTE:
As Types AW and AT signals are available in numerous arrangements of subassemblies and aspects with many options, please contact your GRS sales engineer for ordering information.

TYPES D AND D1 HIGH SIGNAL HEADS

Each signal listed below INCLUDES light units, adjusting bracket, backgrounds and hood(s) (you must specify your choice of plastic or metal backgrounds and hoods), ventilators, 2 ohm adjustable lamp resistor (lamp bulbs are not included), and four-way AAR terminal block. The signals DO NOT INCLUDE the following; please order separately:

- **Bracket and wire entrance material for front-or side-of-pole mounting; see page 15**
- **Deflecting or Spredlite roundels, and Anti-Phan; see page 14**
- **Lamp Exchanger; see page 14**
- **Pole and ladder assemblies; see pages 12 and 13**



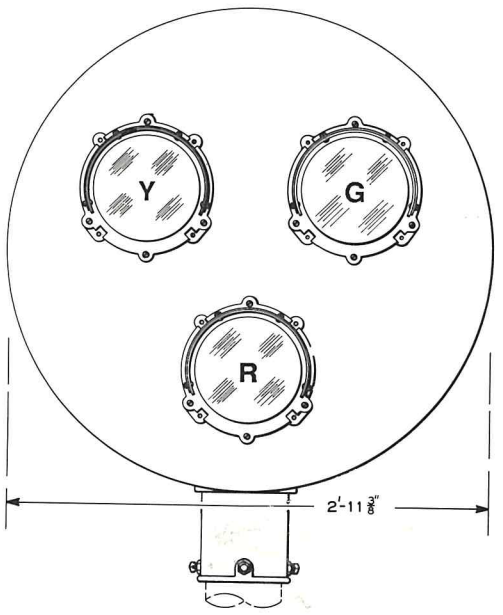
PLEASE ORDER BY CATALOG NUMBER AND NAME SHOWN IN BOLD TYPE

REFERENCE	NAME	CATALOG NUMBER
A	**TYPE D FOUR-ASPECT SIGNAL, aluminum** green/yellow/red/lunar white	**A73-152**
B	**TYPE D THREE-ASPECT SIGNAL, aluminum** green/yellow/red	**A73-111**
B1	**TYPE D1 THREE-ASPECT SIGNAL, polycarbonate** green/yellow/red	**A73-112**
C	**TYPE D TWO-ASPECT SIGNAL, aluminum** yellow/red	**A73-131**
C1	**TYPE D1 TWO-ASPECT SIGNAL, polycarbonate** yellow/red	**A73-132**
D	**TYPE D ONE-ASPECT SIGNAL, aluminum** red	**A73-151**
D1	**TYPE D1 ONE-ASPECT SIGNAL, polycarbonate** red	**A73-150**

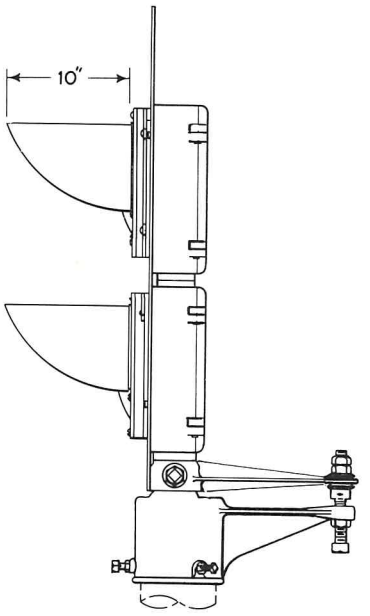
TYPES G AND G1 HIGH SIGNAL HEADS

Each signal listed below INCLUDES light units, adjusting bracket, background and hoods (you must specify your choice of plastic or metal background and hoods), ventilators, and two three-way AAR terminal blocks. Lamp bulbs are not included. The signals also DO NOT INCLUDE the following; please order separately:

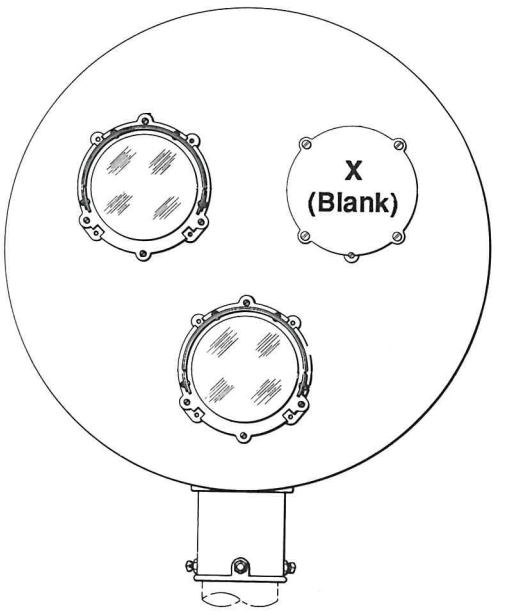
- **Bracket and wire entrance material for front -or side-of-pole mounting; see page 15**
- **Deflecting or Spredlite roundels, and Anti-Phan; see page 14**
- **Lamp Exchanger; see page 14**
- **Pole and ladder assemblies; see page 12 and 13**



A - Front View

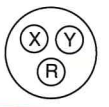
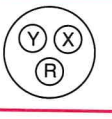
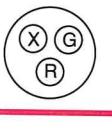


A1 - Side View



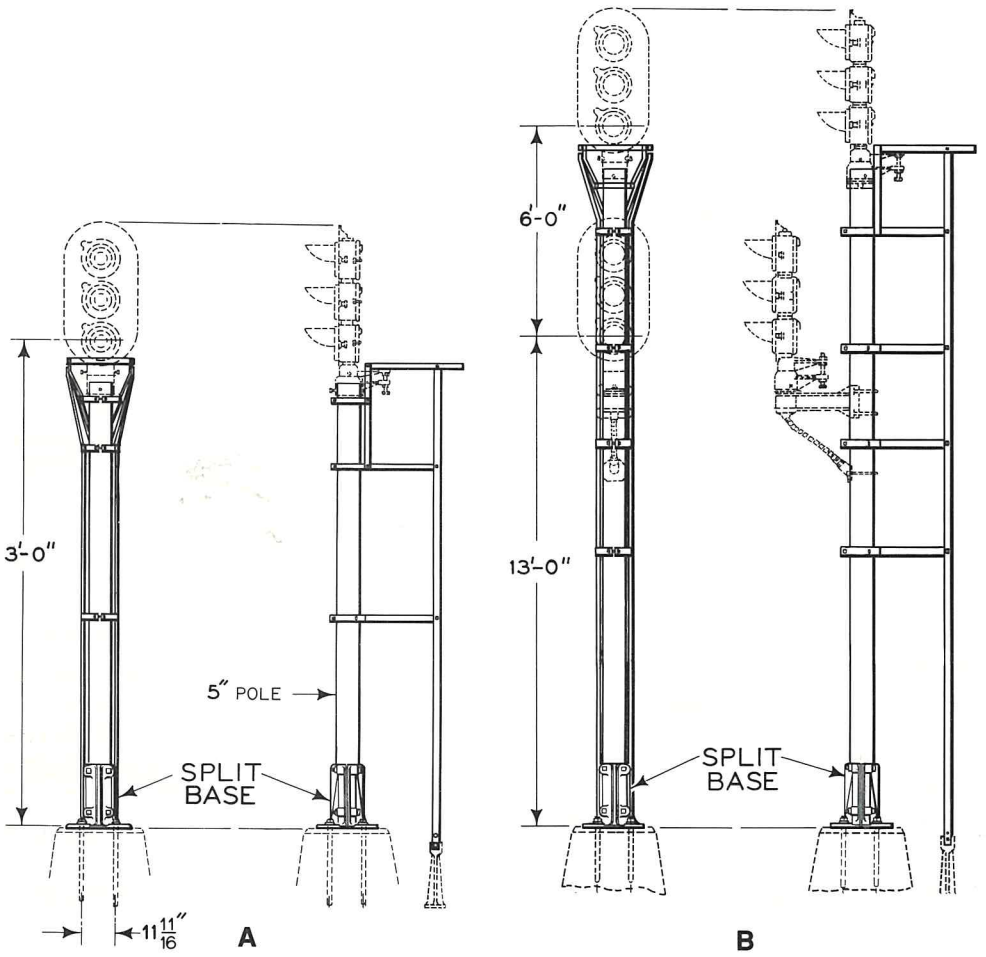
B1 - Front View

PLEASE ORDER BY CATALOG NUMBER AND NAME SHOWN IN BOLD TYPE.

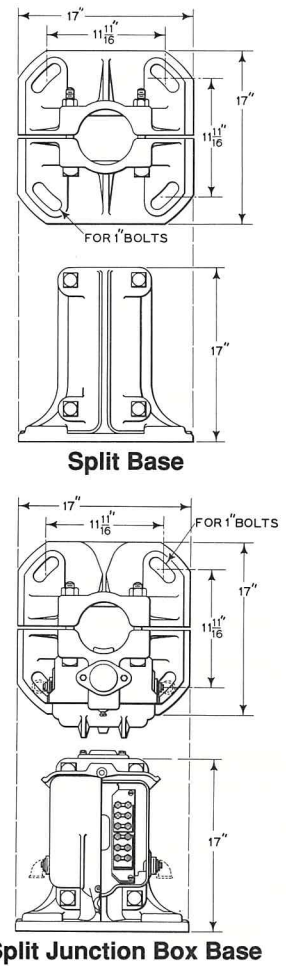
REFERENCE	NAME		CATALOG NUMBER
A	TYPE G THREE-ASPECT SIGNAL, aluminum		A73-230
A1	TYPE G1 THREE-ASPECT SIGNAL, polycarbonate		A73-231
B	TYPE G TWO-ASPECT SIGNAL, aluminum		A73-232
B1	TYPE G TWO-ASPECT SIGNAL, aluminum		A73-233
B2	TYPE G1 TWO-ASPECT, polycarbonate		A73-908
B3	TYPE G1 TWO-ASPECT, polycarbonate		A73-909

POLE AND LADDER ASSEMBLIES
For Types D, D1, G and G1 Signals

Steel poles have 5" inside diameter. Pole heights are approximate, and they come complete with base, ladder, and platform. To order ladder supports or foundations, see page 13.



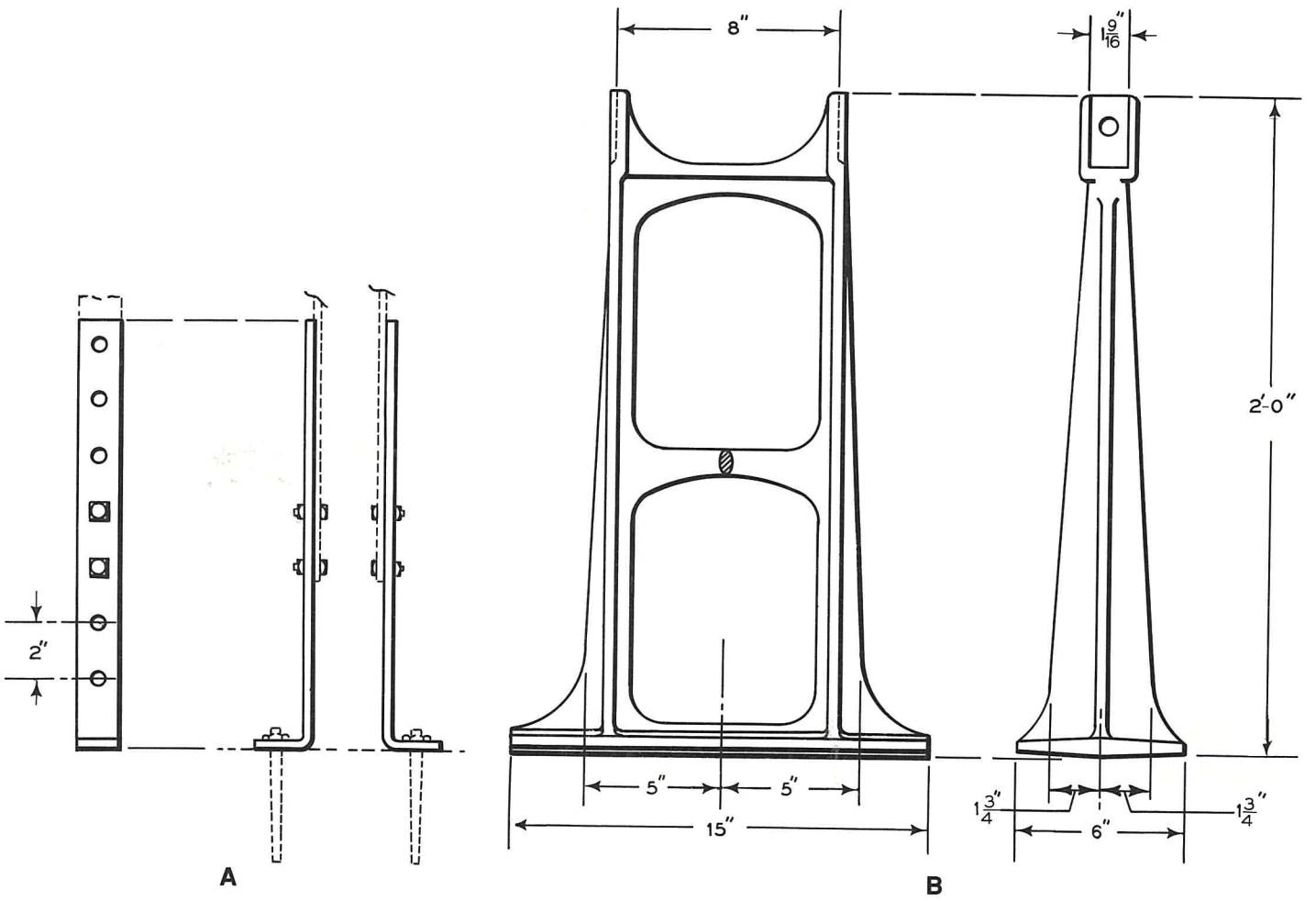
Cast Aluminum Bases included With Signal Pole Assemblies



TO ORDER, SPECIFY "POLE ASSEMBLY" AND CATALOG NUMBER.

REFERENCE	DRILLED FOR SIGNAL HEADS	TYPE OF BASE	CATALOG NUMBER
A	None	Split	A73-181
A1	None	Split Junction Box	A73-183
B	One	Split	A73-189
B1	One	Split Junction Box	A73-191

LADDER SUPPORT AND FOUNDATION
For Types D, D1, G and G1 Signals

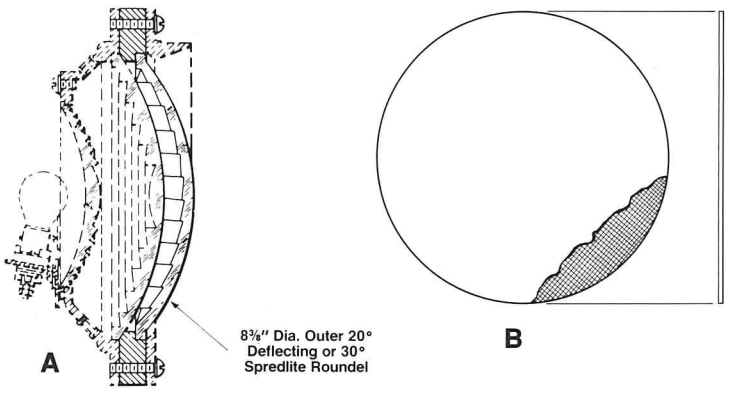


PLEASE ORDER BY CATALOG NUMBER AND NAME SHOWN IN BOLD TYPE.

REFERENCE	NAME	CATALOG NUMBER
A	**LADDER SUPPORT,** adjustable for use when ladder is to be fastened directly to flat surface; order includes bolts and nuts for attaching to ladder	**A76-325**
B	**FOUNDATION,** for ladder; includes bolts and nuts	**A76-327**

ROUNDEL ASSEMBLIES AND ANTI-PHAN
For Types D, D1, G, and G1 Signals

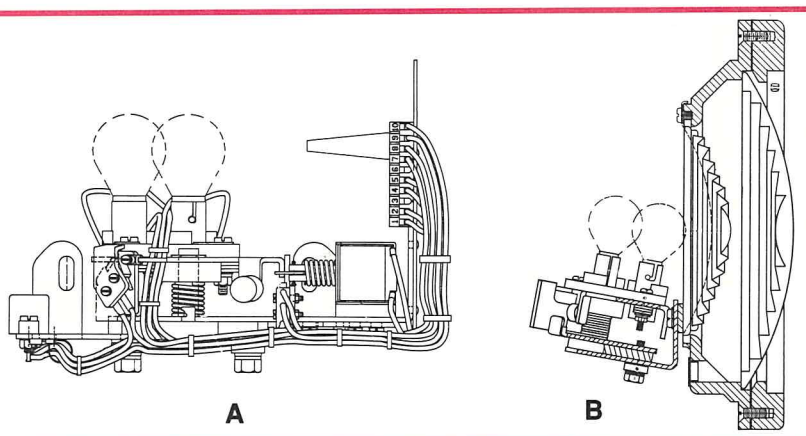
Types D, D1, G, and G1 signal heads, furnished with 8-3/8" lenses for tangent track only, can be adapted easily for specific conditions by the addition of a roundel, which comes ready for installation, except for sealing compound, for which GRS recommends Sealing Compound 90B0010. For other roundels and lenses, see Parts Catalog Sections P73 and P76.



PLEASE ORDER BY CATALOG NUMBER AND NAME SHOWN IN BOLD TYPE.

REFERENCE	NAME	CATALOG NUMBER
A	**ROUNDEL ASSEMBLY,** 20° deflecting	**P73-414**
A1	**ROUNDEL ASSEMBLY,** same as Ref. A, except 30° Spredlite	**P73-415**
B	**ANTI-PHAN**	**A73-205**

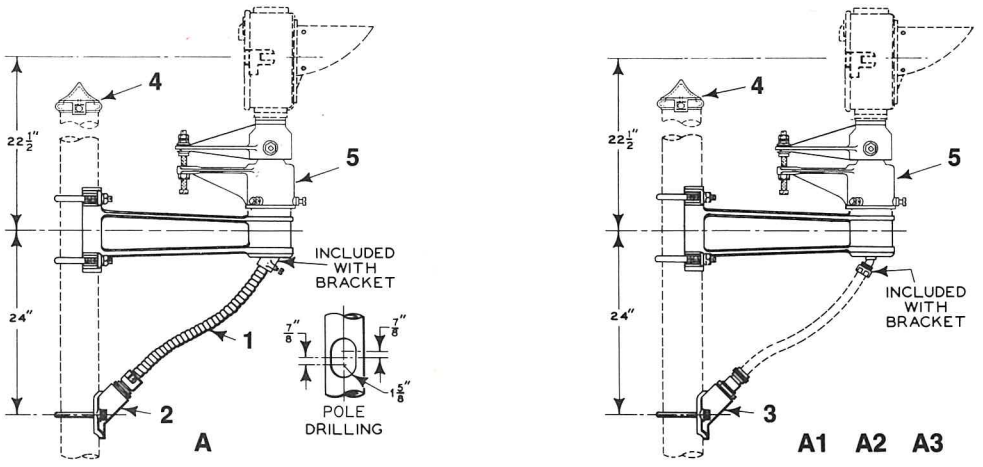
LAMP EXCHANGER
For Types D, D1, and G1 Signals



PLEASE ORDER BY CATALOG NUMBER AND NAME SHOWN IN BOLD TYPE.

REFERENCE	NAME	CATALOG NUMBER
A	**LAMP EXCHANGER,** (lamp bulbs are not included)	**A73-902**
B	**LENS UNIT COMPLETE**, with lamp exchanger and red lens	**A73-903**
B1	**LENS UNIT COMPLETE,** same as B, except yellow lens	**A73-904**
B2	**LENS UNIT COMPLETE,** same as B, except green lens	**A73-905**
B3	**LENS UNIT COMPLETE,** same as B, except lunar white lens	**A73-906**

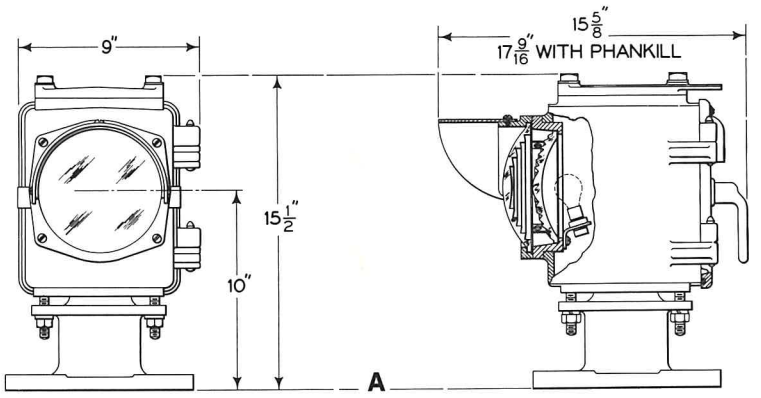
MOUNTING BRACKETS, CONDUIT AND COUPLINGS
For Types D, D1, G and G1 Signals



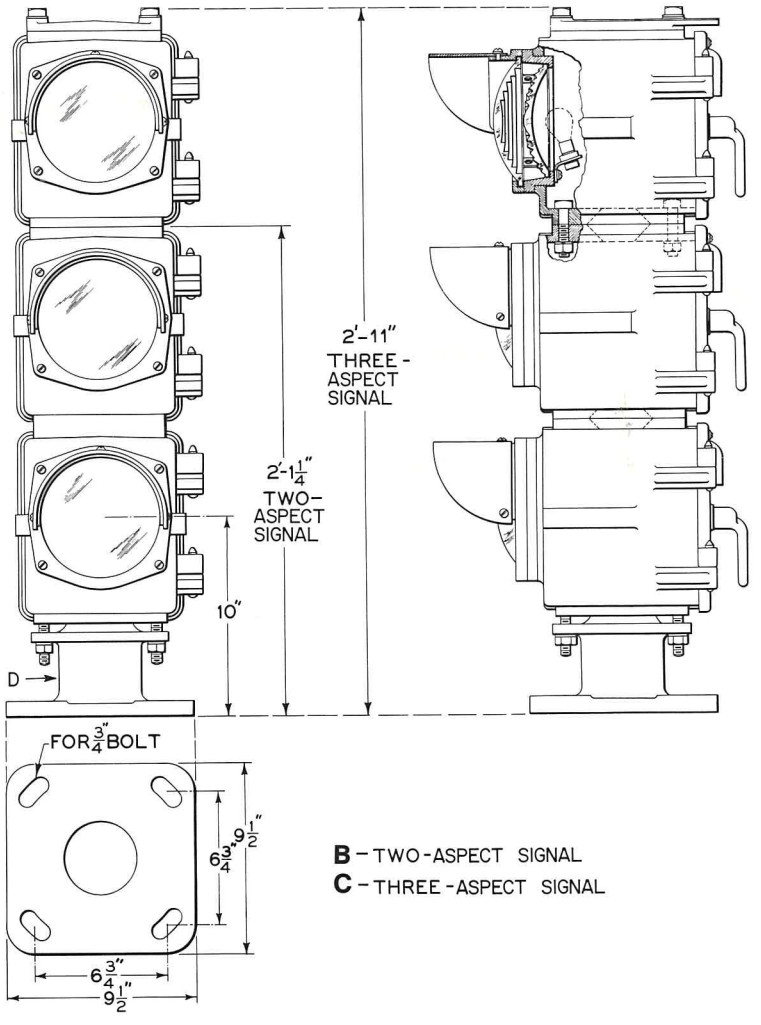
PLEASE ORDER BY CATALOG NUMBER AND NAME SHOWN IN BOLD TYPE.

REFERENCE	NAME	CATALOG NUMBER
A	**BRACKET COMPLETE,** for mounting a Type D, D1, G, or G1 signal on side of mast. Includes 45° couplings for 1-1/2" flexible conduit and "U" bolts, nuts, and washers for attaching to 5" pole	**A73-161**
A1	As above, except with coupling for 3/4" to 7/8" dia. cable	**A73-165**
A2	Same as Ref. A1, except for 7/8" to 1.0" dia. cable	**A73-167**
A3	Same as Ref. A1, except for 1.0" to 1-3/16" dia. cable	**A73-169**
1	**CONDUIT**, 1-1/2" flexible, recommended length 2'3", specify length required	**A85-868**
2	**COUPLING,*** complete with "U" bolt and gasket, for 1-1/2" flexible conduit	**A76-568**
3	**COUPLING,*** complete with "U" bolt, reducer, and gasket, for 3/4" to 7/8" dia. cable	**A76-530**
3a	**COUPLING,*** complete with "U" bolt, reducer, and gasket for 7/8" to 1.0" dia. cable	**A76-531**
3b	**COUPLING,*** complete with "U" bolt, reducer, and gasket for 1.0" to 1-3/16" dia.cable	**A76-532**
4	**PINNACLE,** for 5" pole	**A30-521**
5	**ADJUSTING BRACKET**, fits 5" pole or mounting bracket, Refs. A-A3	**P73-270**

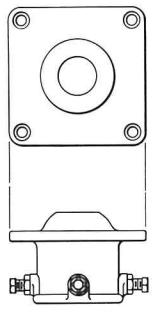
*Poles with welded couplings do not require this coupling.



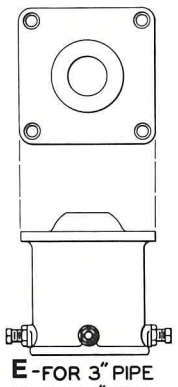
A
ONE – ASPECT SIGNAL



B – TWO-ASPECT SIGNAL
C – THREE-ASPECT SIGNAL



D – FOR 2 1/2" PIPE



E – FOR 3" PIPE
F – FOR 4" PIPE

TYPE FA DWARF SIGNAL

Each Type FA signal listed below INCLUDES a four-way AAR terminal block, ventilators, and 2-ohm adjustable lamp resistor. The Type FA signal DOES NOT INCLUDE the following; please order separately:

- **Pole mounting socket; see below.**
- **Deflecting or Spredlite roundels, and Phankill; see below.**
- **Type K1/2 transformer; see Assemblies Catalog 95-1.**

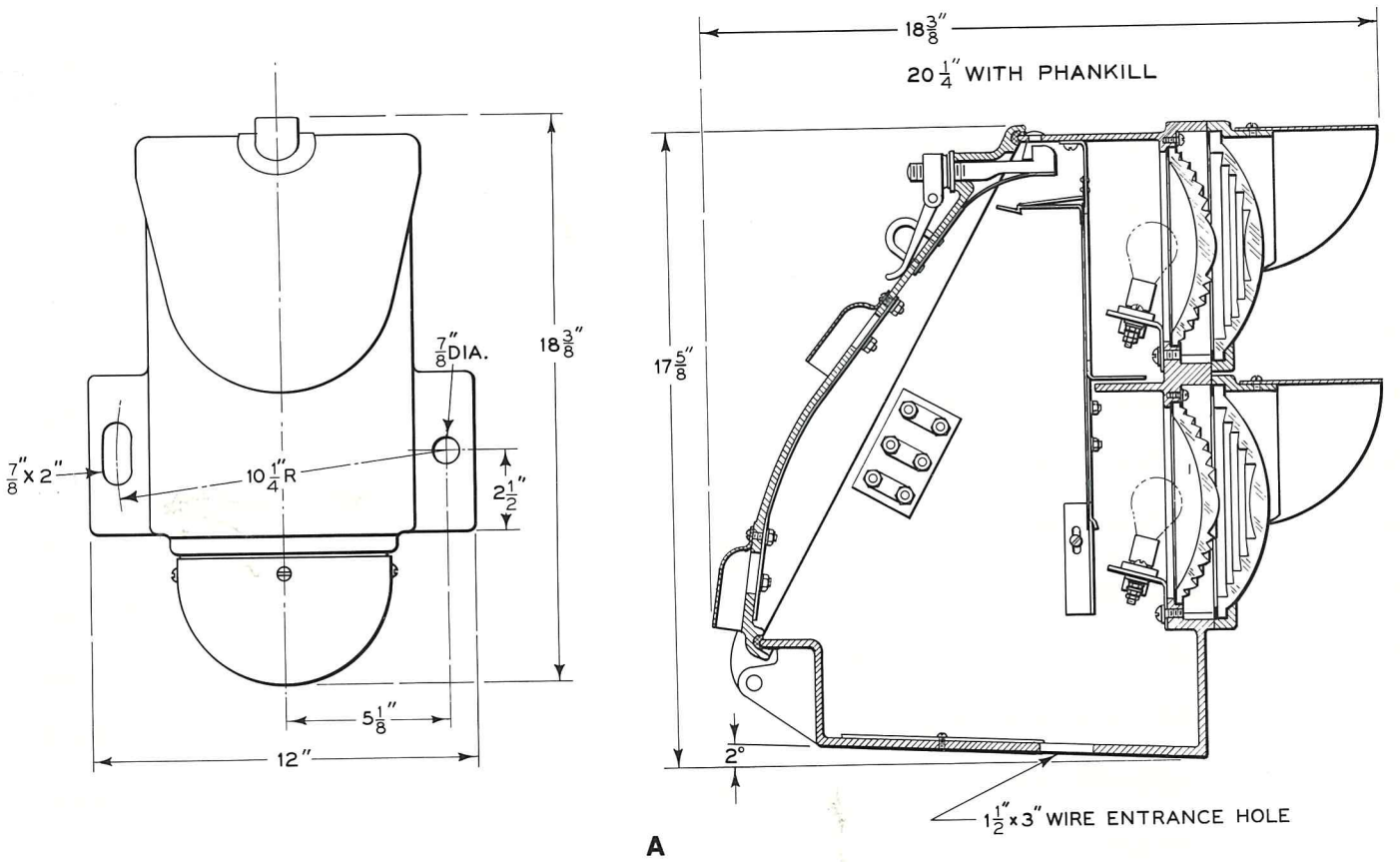
PLEASE ORDER BY CATALOG NUMBER AND NAME SHOWN IN BOLD TYPE.

REFERENCE	NAME	CATALOG NUMBER
A	**TYPE FA ONE-ASPECT SIGNAL,** red	**A73-510**
A1	**TYPE FA ONE-ASPECT SIGNAL,** yellow	**A73-512**
B	**TYPE FA TWO-ASPECT SIGNAL,** yellow/red	**A73-530**
B1	**TYPE FA TWO-ASPECT SIGNAL,** green/red	**A73-532**
C	**TYPE FA THREE-ASPECT SIGNAL,** green/yellow/red	**A73-550**
C1	**TYPE FA THREE-ASPECT SIGNAL,** red/yellow/green	**A73-552**
D	**SOCKET, for pole mounting,** fits 2-1/2" I.D. pipe	**A73-590**
E	**SOCKET, for pole mounting,** fits 3" I.D. pipe	**A73-592**
F	**SOCKET, for pole mounting,** fits 4" I.D. pipe	**A73-594**
	ROUNDEL ASSEMBLY, 20° deflecting	**P73-419**
	ROUNDEL ASSEMBLY, same as above except 30° Spredlite	**P73-420**
	PHANKILL ASSEMBLY, with clear lens and roundel, complete with all parts to install	**P73-426**

TYPE MD DWARF SIGNAL

Each Type MD signal listed below INCLUDES a three-way AAR terminal block, ventilators, and a 2-ohm adjustable lamp resistor. The Type MD signal DOES NOT INCLUDE the following; please order separately:

- **Deflecting or Spredlite roundels, and Phankill; see below.**
- **Type S transformer; see Assemblies Catalog 95-1.**
- **Type K relay; see Assemblies Catalog Section 65.**



A

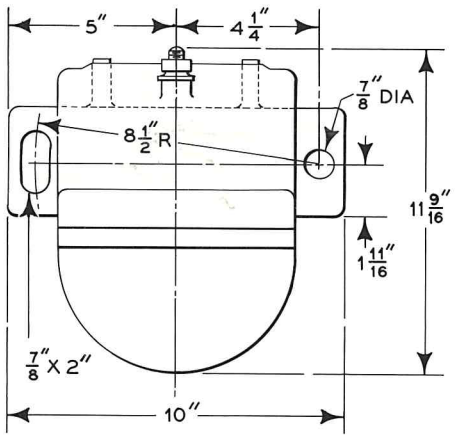
PLEASE ORDER BY CATALOG NUMBER AND NAME SHOWN IN BOLD TYPE.

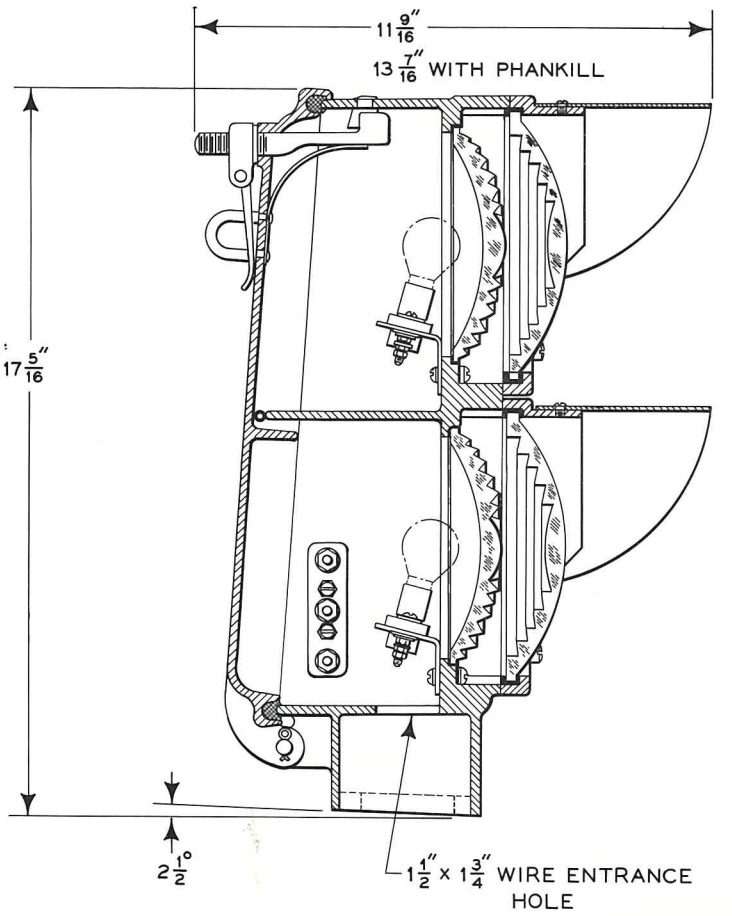
REFERENCE	NAME	CATALOG NUMBER
A	**TYPE MD TWO-ASPECT SIGNAL,** yellow/red	**A73-640**
A1	**TYPE MD TWO-ASPECT SIGNAL,** green/red	**A73-642**
	ROUNDEL ASSEMBLY, 20° deflecting	**P73-417**
	ROUNDEL ASSEMBLY, same as above except 25° Spredlite	**P73-418**
	PHANKILL ASSEMBLY, with clear lens and roundel, complete with all parts to install	**P73-425**

TYPE ME DWARF SIGNAL

Each Type ME signal listed below INCLUDES a three-way AAR terminal block and a 2-ohm adjustable lamp resistor. The Type ME signal DOES NOT INCLUDE the following; please order separately:

- **Deflecting or Spredlite roundels, and Phankill; see below.**
- **Type S transformer; see Assemblies Catalog 95-1.**
- **Type K relay; see Assemblies Catalog Section 65**





A

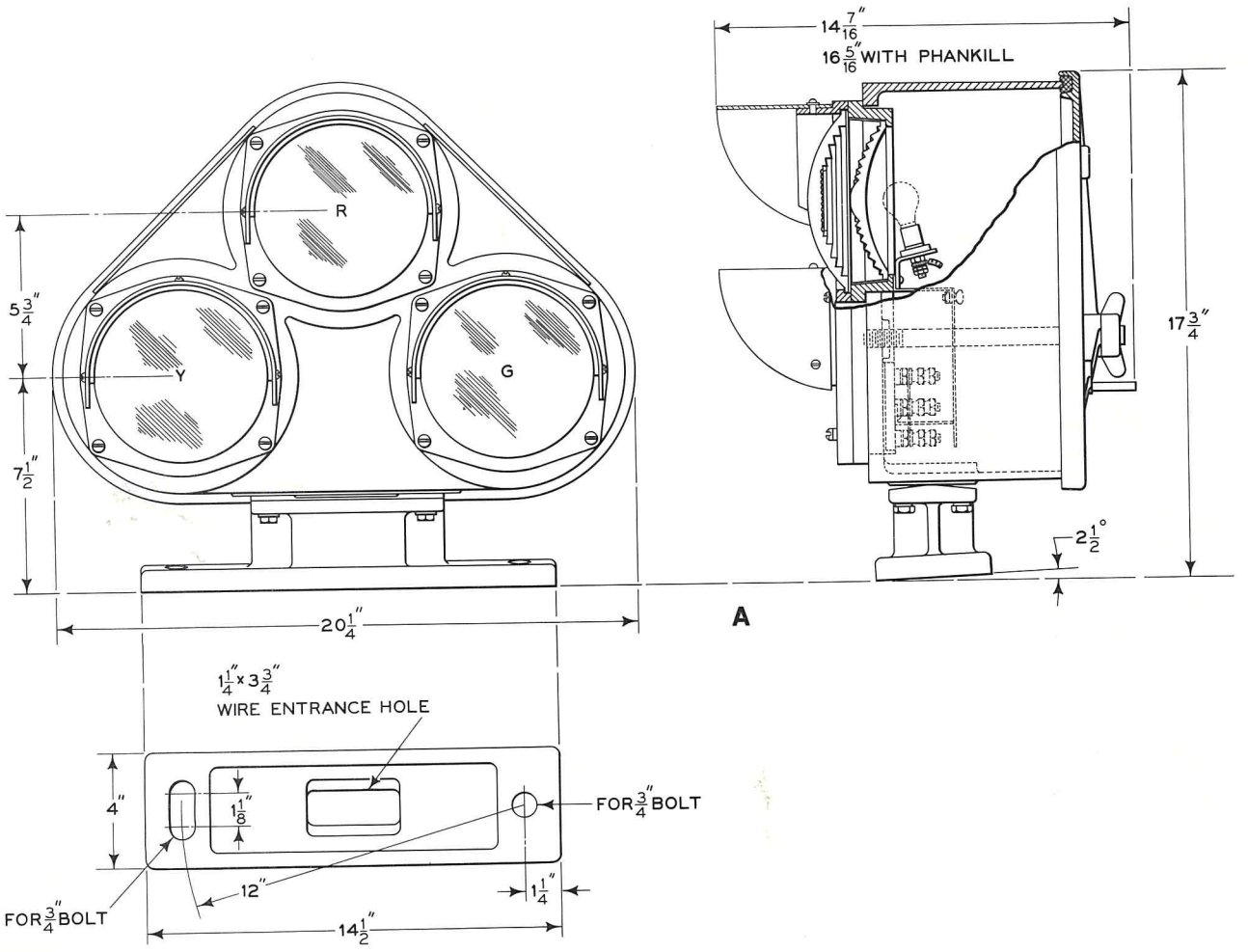
PLEASE ORDER BY CATALOG NUMBER AND NAME SHOWN IN BOLD TYPE.

REFERENCE	NAME	CATALOG NUMBER
A	**TYPE ME TWO-ASPECT SIGNAL,** yellow/red	**A73-610**
A1	**TYPE ME TWO-ASPECT SIGNAL,** green/red	**A73-612**
	ROUNDEL ASSEMBLY, 20° deflecting	**P73-417**
	ROUNDEL ASSEMBLY, same as above except 25° Spredlite	**P73-418**
	PHANKILL ASSEMBLY, with clear lens and roundel, complete with all parts to install	**P73-425**

TYPE MF DWARF SIGNAL

Each Type MF signal listed below INCLUDES a three-way AAR terminal block and a 2-ohm adjustable lamp resistor. The Type ME signal DOES NOT INCLUDE the following; please order separately:

- **Deflecting or Spredlite roundels, and Phankill; see below.**



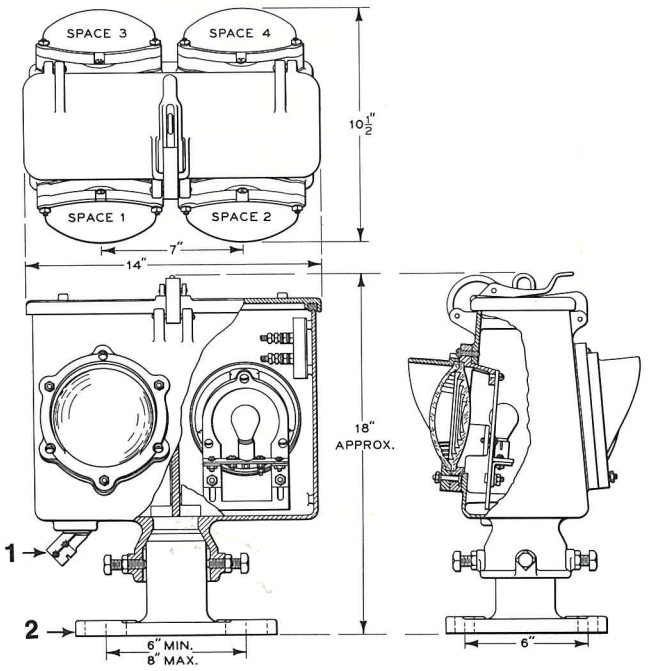
PLEASE ORDER BY CATALOG NUMBER AND NAME SHOWN IN BOLD TYPE.

REFERENCE	NAME	CATALOG NUMBER
A	**TYPE MF THREE-ASPECT SIGNAL,** red/yellow/green	**A73-670**
	ROUNDEL ASSEMBLY, 20° deflecting	**P73-419**
	ROUNDEL ASSEMBLY, same as above except 25° Spredlite	**P73-420**
	PHANKILL ASSEMBLY, with clear lens and roundel, complete with all parts to install	**P73-426**

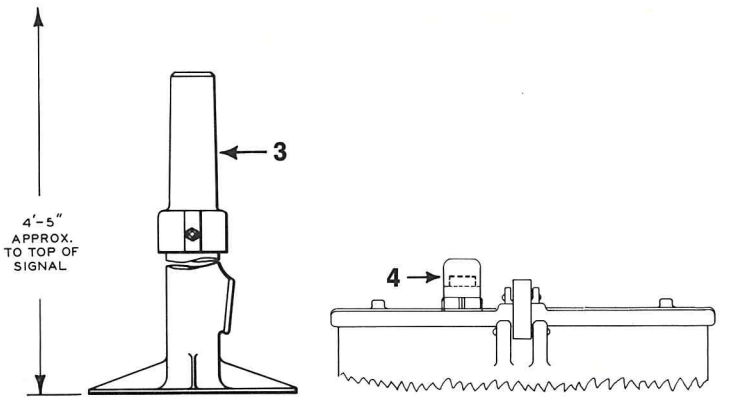
TYPE P COLOR-LIGHT SIGNAL

Each Type P signal listed below INCLUDES two-way terminal blocks. Type P signals DO NOT INCLUDE the following; please order separately:

- **Conduit connector; see below.**
- **Standard base or pedestal base; see below.**
- **Pushbutton; see below.**



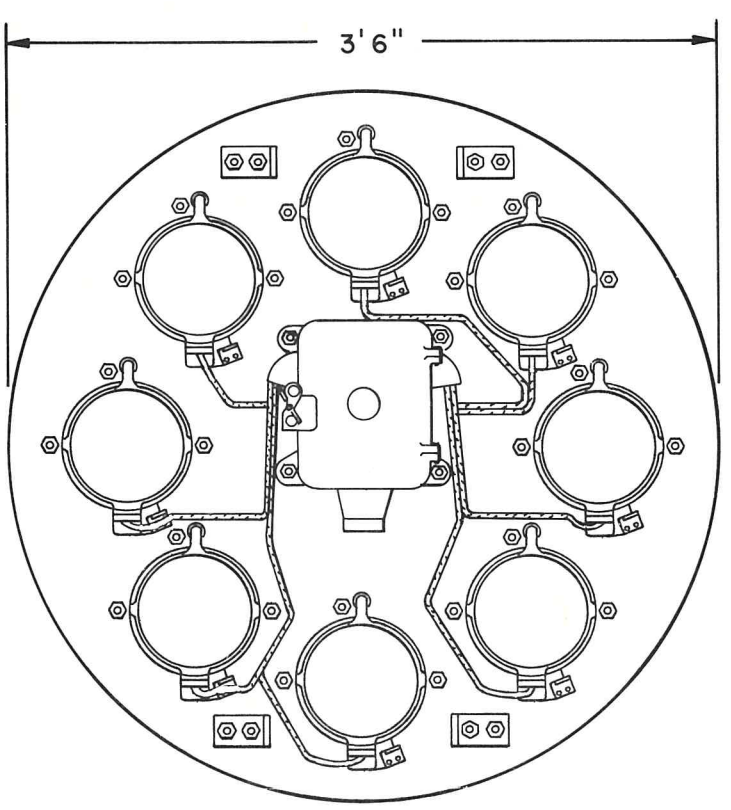
Standard-type base



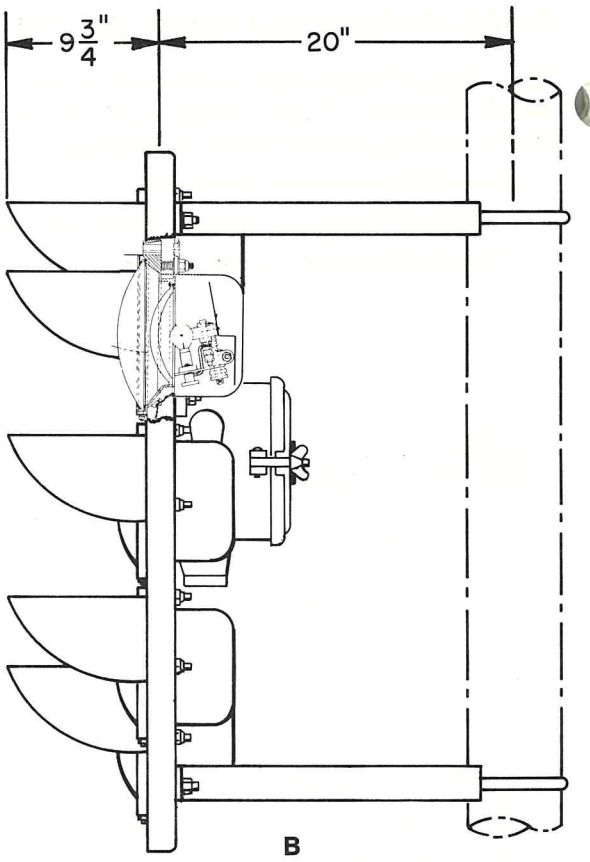
Pedestal-type base

PLEASE ORDER BY CATALOG NUMBER AND NAME SHOWN IN BOLD TYPE.

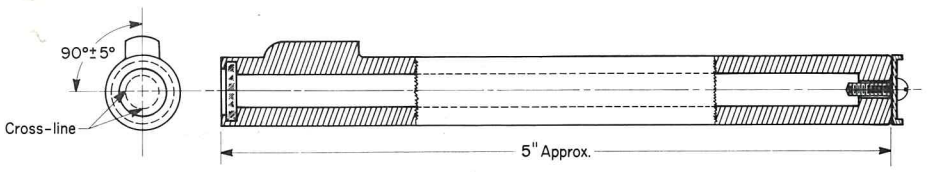
REFERENCE	NAME	Aspects Space 1	Space 2	Space 3	Space 4	CATALOG NUMBER
A	**TYPE P SIGNAL,**	Red	Green	Red	Green	**A73-700**
A1	**TYPE P SIGNAL,**	Yellow	L.White	Yellow	L. White	**A73-701**
A2	**TYPE P SIGNAL,**	Yellow	Green	Yellow	Green	**A73-702**
A3	**TYPE P SIGNAL,**	Yellow	Red	Red	Yellow	**A73-703**
1	**CONNECTOR,** for 3/4" flexible conduit, not used with pedestal base					**P73-918**
2	**BASE,** for foundation mounting					**P73-906**
3	**BASE,** pedestal type					**P73-905**
4	**PUSHBUTTON,** for local control					**P73-1005**



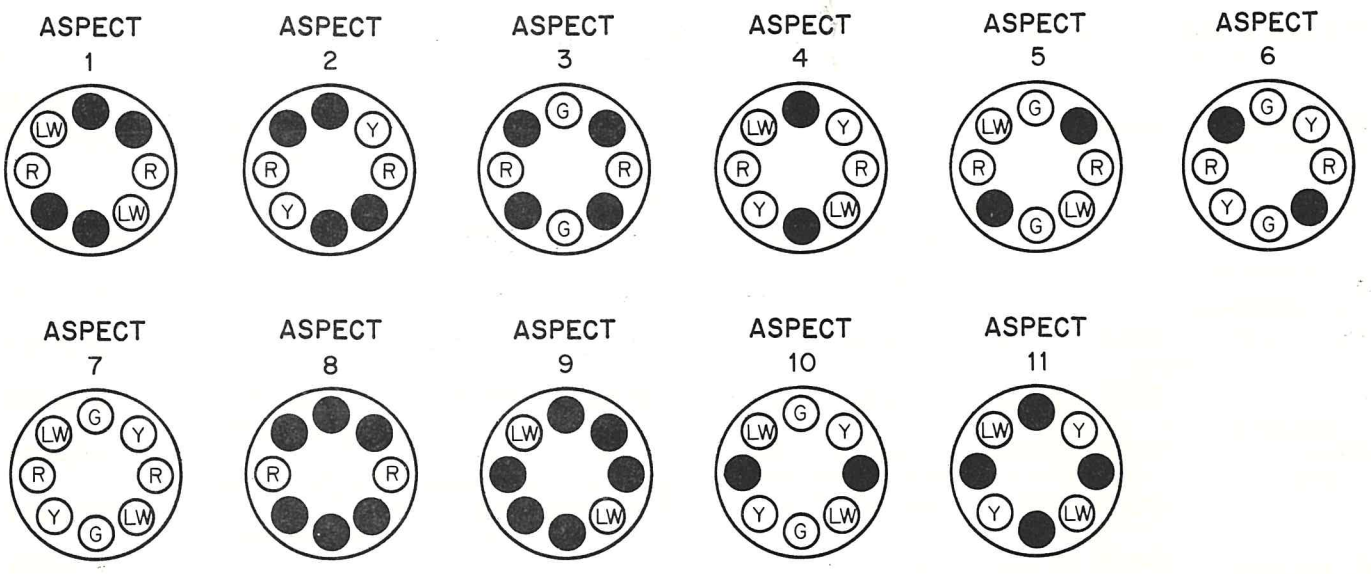
A



B



C



NOTE: DARKENED SPOTS ARE PLUGGED HOLES WITH NO LIGHT UNIT.

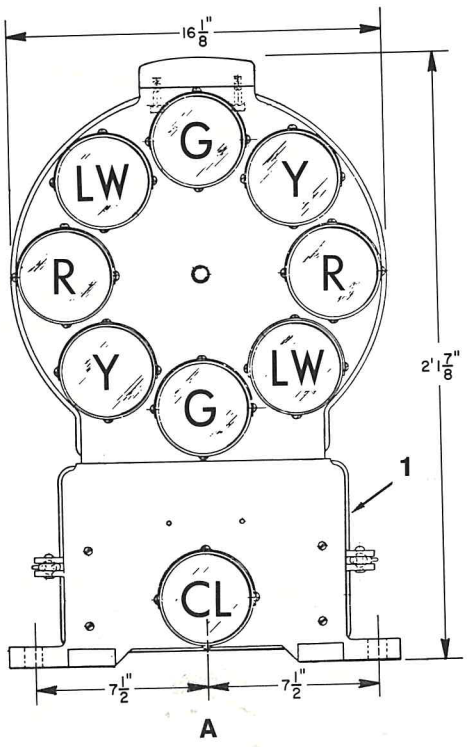
TYPE U COLOR-POSITION-LIGHT HIGH SIGNAL

The Type U aluminum color-position-light high signal INCLUDES a choice of aspects as shown on page 22 and listed below. The Type U signal DOES NOT INCLUDE the following; please order separately:

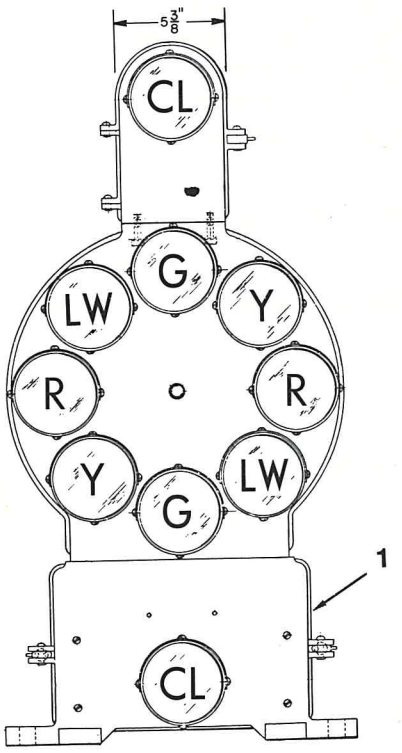
- **Mounting brackets with U bolts; see below.**
- **Sighting device; see below.**
- **Transformers; see Assemblies Catalog 95-1.**

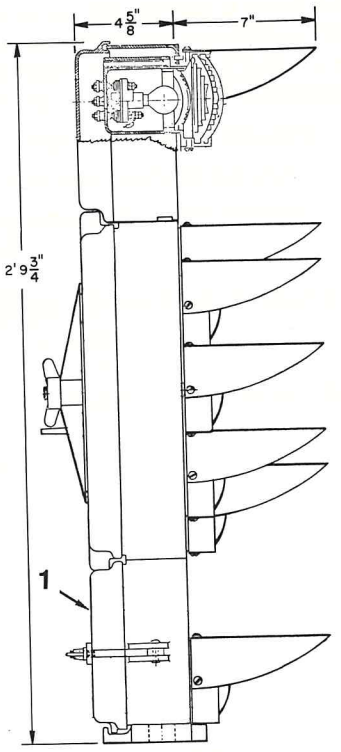
PLEASE ORDER BY CATALOG NUMBER AND NAME SHOWN IN BOLD TYPE.

REFERENCE	NAME	CATALOG NUMBER
A	**TYPE U SIGNAL ASPECT 1**	**A73-875**
A	**TYPE U SIGNAL ASPECT 2**	**A73-876**
A	**TYPE U SIGNAL ASPECT 3**	**A73-877**
A	**TYPE U SIGNAL ASPECT 4**	**A73-878**
A	**TYPE U SIGNAL ASPECT 5**	**A73-879**
A	**TYPE U SIGNAL ASPECT 6**	**A73-880**
A	**TYPE U SIGNAL ASPECT 7**	**A73-881**
A	**TYPE U SIGNAL ASPECT 8**	**A73-882**
A	**TYPE U SIGNAL ASPECT 9**	**A73-883**
A	**TYPE U SIGNAL ASPECT 10**	**A73-884**
A	**TYPE U SIGNAL ASPECT 11**	**A73-885**
B	**MOUNTING BRACKET,** set of 2 for 5" pole	**A73-895**
B1	As above, except for 6" pole	**A73-896**
C	**SIGHTING DEVICE**	**A73-897**

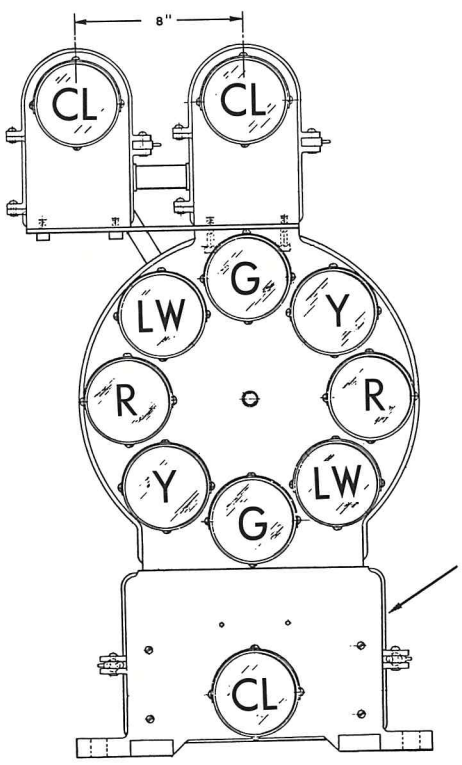

16 1/8"
2'1 7/8"
CL
G
Y
LW
R
R
Y
G
LW
1
7 1/2"
7 1/2"

A

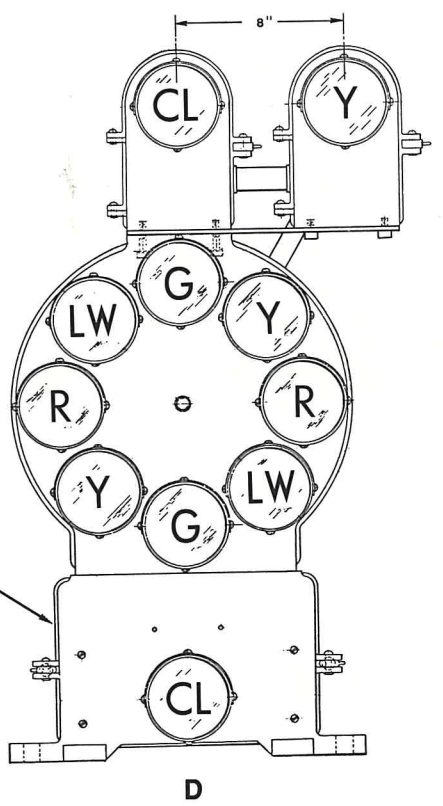

5 3/8"
CL
G
Y
LW
R
R
Y
G
LW
1
CL


4 5/8"
7"
2'9 3/4"
1

B


8"
CL
CL
G
Y
LW
R
R
Y
G
LW
1
CL

C


8"
CL
Y
G
Y
LW
R
R
Y
G
LW
1
CL

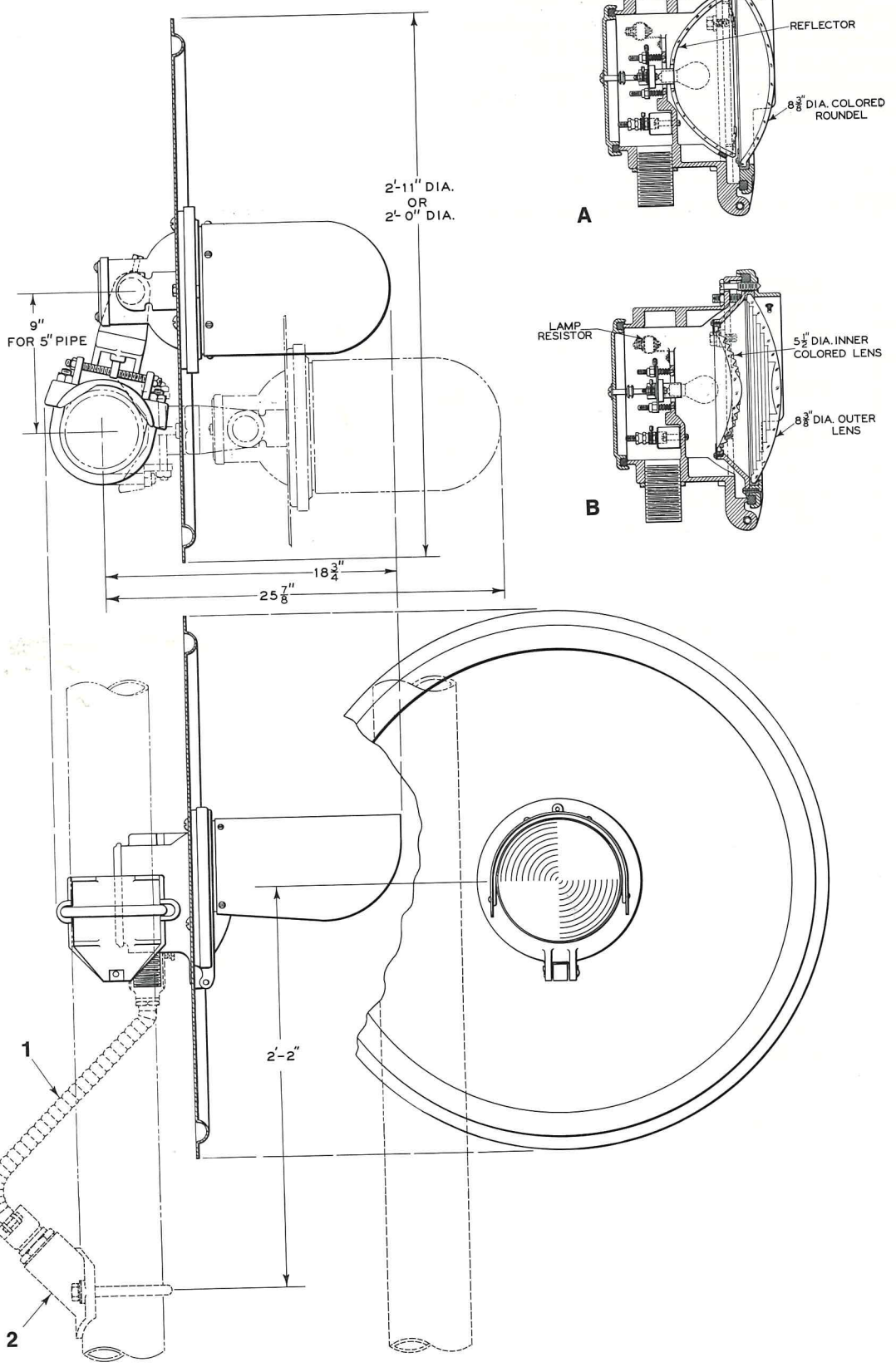
D

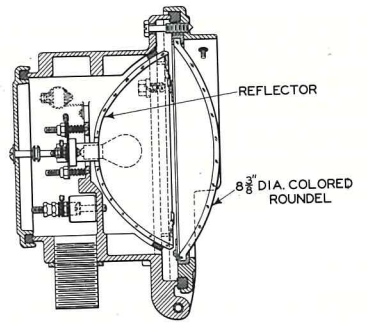
TYPE VA COLOR-POSITION-LIGHT DWARF SIGNAL

The Type VA cast aluminum color-position-light dwarf signal INCLUDES a choice of marker light aspects as listed below. For a different arrangement of the primary eight aspects shown on page 24, specify by the aspect numbers shown on page 22. The signal DOES NOT INCLUDE a deflecting roundel as listed below (please order separately).

PLEASE ORDER BY CATALOG NUMBER AND NAME SHOWN IN BOLD TYPE.

REFERENCE	NAME	CATALOG NUMBER
A	**TYPE VA SIGNAL,** with bottom clear lens marker	**A73-870**
B	**TYPE VA SIGNAL,** with top and bottom clear lens markers	**A73-871**
C	**TYPE VA SIGNAL,** with two top and one bottom clear lens markers	**A73-872**
D	**TYPE VA SIGNAL,** with top clear and yellow, and bottom clear lens markers	**A73-873**
	ROUNDEL, 20° deflecting, clear	**P73-977**
1	**CASE COMPLETE,** for replacement, with blanking disc covering lens opening	**A73-910**


2'-11" DIA.
OR
2'-0" DIA.
9"
FOR 5" PIPE
18 3/4"
25 7/8"
2'-2"
1
2


REFLECTOR
8 3/8" DIA. COLORED
ROUNDEL

A

LAMP
RESISTOR
5 1/2" DIA. INNER
COLORED LENS
8 3/8" DIA. OUTER
LENS

B

TYPE W MARKER SIGNAL

The Type W marker signals listed below INCLUDE a two-way AAR terminal block and a choice of background sizes and optical systems. The signals DO NOT INCLUDE the following; please order separately:

- **Anti-Phan; see page 14.**
- **Conduit and coupling; see below.**

PLEASE ORDER BY CATALOG NUMBER AND NAME SHOWN IN BOLD TYPE.

REFERENCE	NAME	CATALOG NUMBER With 2-ohm 1.75 amp. lamp resistor	CATALOG NUMBER With 5-ohm 1.0 amp. lamp resistor
A	**TYPE W SIGNAL,** with red aspect, 2'-11" dia. background, and reflector and roundel	**A73-808**	**A73-816**
A1	**TYPE W SIGNAL,** with frosted aspect, 2'-11" dia. background, and reflector and roundel	**A73-809**	**A73-817**
A2	**TYPE W SIGNAL,** with red aspect, 2'-0" dia. background, and reflector and roundel	**A73-810**	**A73-818**
A3	**TYPE W SIGNAL,** with frosted aspect, 2'-0" dia. background, and reflector and roundel	**A73-811**	**A73-819**
B	**TYPE W SIGNAL,** with red aspect, 2'-11" dia. background, and doublet lens	**A73-839**	**A73-843**
B1	**TYPE W SIGNAL,** with red aspect, 2'-0" dia. background, and doublet lens	**A73-840**	**A73-845**
1	**CONDUIT COMPLETE,** 3/4" flexible, includes all parts for connecting signal housing to coupling	**P73-233**	
2	**COUPLING,** complete with U bolt, for 3/4" flexible conduit	**A73-860**	

GENERAL RAILWAY SIGNAL
A UNIT OF GENERAL SIGNAL

MAIN OFFICE AND PLANT
PO BOX 20600 ROCHESTER NY 14602-0600 Phone: 716 • 436-2020 Cable: GENRASIG (ROCHESTER NY) Telex: 978317

BOSTON OFFICE
THE 128/ONE EXECUTIVE OFFICE BUILDING 990 WASHINGTON STREET SUITE 106 DEDHAM MA 02026-6790
Phone: 617 • 329-6212

CHICAGO OFFICE
PRUDENTIAL PLAZA SUITE 2120 CHICAGO IL 60601 Phone: 312 • 467-1221

JACKSONVILLE OFFICE
8657 BAYPINE ROAD SUITE 209 JACKSONVILLE FL 32256 Phone: 904 • 739-1900

KANSAS CITY OFFICE
10220 NORTH EXECUTIVE HILLS BOULEVARD SUITE 456 KANSAS CITY MO 64153 Phone: 816 • 891-7211

MONTREAL OFFICE
POINTE-CLAIRE COMMERCE CENTER 6600 TRANSCANADA HIGHWAY SUITE 320 POINTE-CLAIRE QUEBEC H9R 4S2
Phone: 514 • 694-7350

NEW YORK OFFICE
230 PARK AVENUE ROOM 928 NEW YORK NY 10169 Phone: 212 • 697-3681

OMAHA OFFICE
8031 WEST CENTER ROAD SUITE 209 OMAHA NE 68124 Phone: 402 • 399-9333

ROANOKE OFFICE
LIBERTY TRUST BUILDING 101 SOUTH JEFFERSON STREET SUITE 505 ROANOKE VA 24011 Phone: 703 • 343-8628

SAN RAMON OFFICE
CROW CANYON OFFICE PARK 12 CROW CANYON COURT SUITE 210 SAN RAMON CA 94583
Phone: 415 • 831-8775

WASHINGTON OFFICE
MONTGOMERY CENTER 8630 FENTON STREET SUITE 613 SILVER SPRING MD 20910 Phone: 301 • 587-4770

GRS INTERNATIONAL

MAIN OFFICE AND PLANT
PO BOX 20600 ROCHESTER NY U.S.A. 14602-0600 Phone: 716 • 436-2020
Cable: GENRASIG (ROCHESTER NY) Telex: 978317

G.R.S. TRADING CORPORATION
PO BOX 20600 ROCHESTER NY U.S.A. 14602-0600 Phone: 716 • 436-2020
Cable: GENRASIG (ROCHESTER NY) Telex: 978317

GEC-GENERAL SIGNAL LIMITED
BOREHAMWOOD INDUSTRIAL PARK ROWLEY LANE BOREHAMWOOD HERTFORDSHIRE WD6 5PZ ENGLAND
Phone: 44-1-953-9922 Cable: RAILSIGKO BOREHAMWOOD (ENGLAND) Telex: 851-916129 GEC GS

ALGEMENE SEIN INDUSTRIE B.V.
CROESELAAN 28 3521 CB UTRECHT NETHERLANDS Phone: 31-30-94-26-46
Cable: GENRASIG UTRECHT (NETHERLANDS) Telex: 844-47455 GRASI NL

CASCO SIGNAL LIMITED
UNION BUILDING 100 YAN AN DONG ROAD SHANGHAI PEOPLES REPUBLIC OF CHINA Phone: 86-21-26-0579, 86-21-26-5545

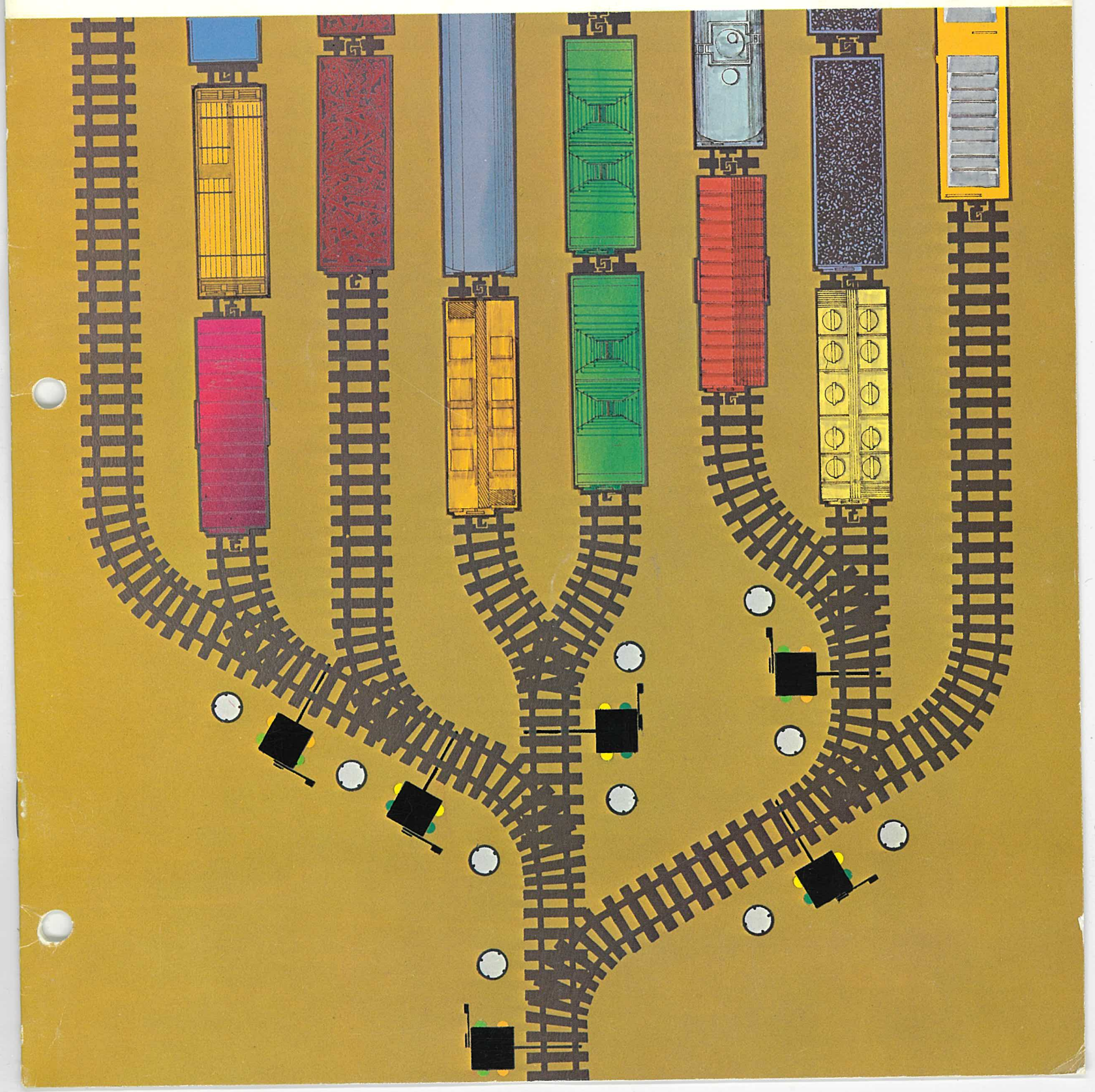
REPRESENTATIVES AND LICENSEES THROUGHOUT THE WORLD

SWITCH MACHINES

SPEED-FRATER®
ELECTRIC SWITCH MACHINE

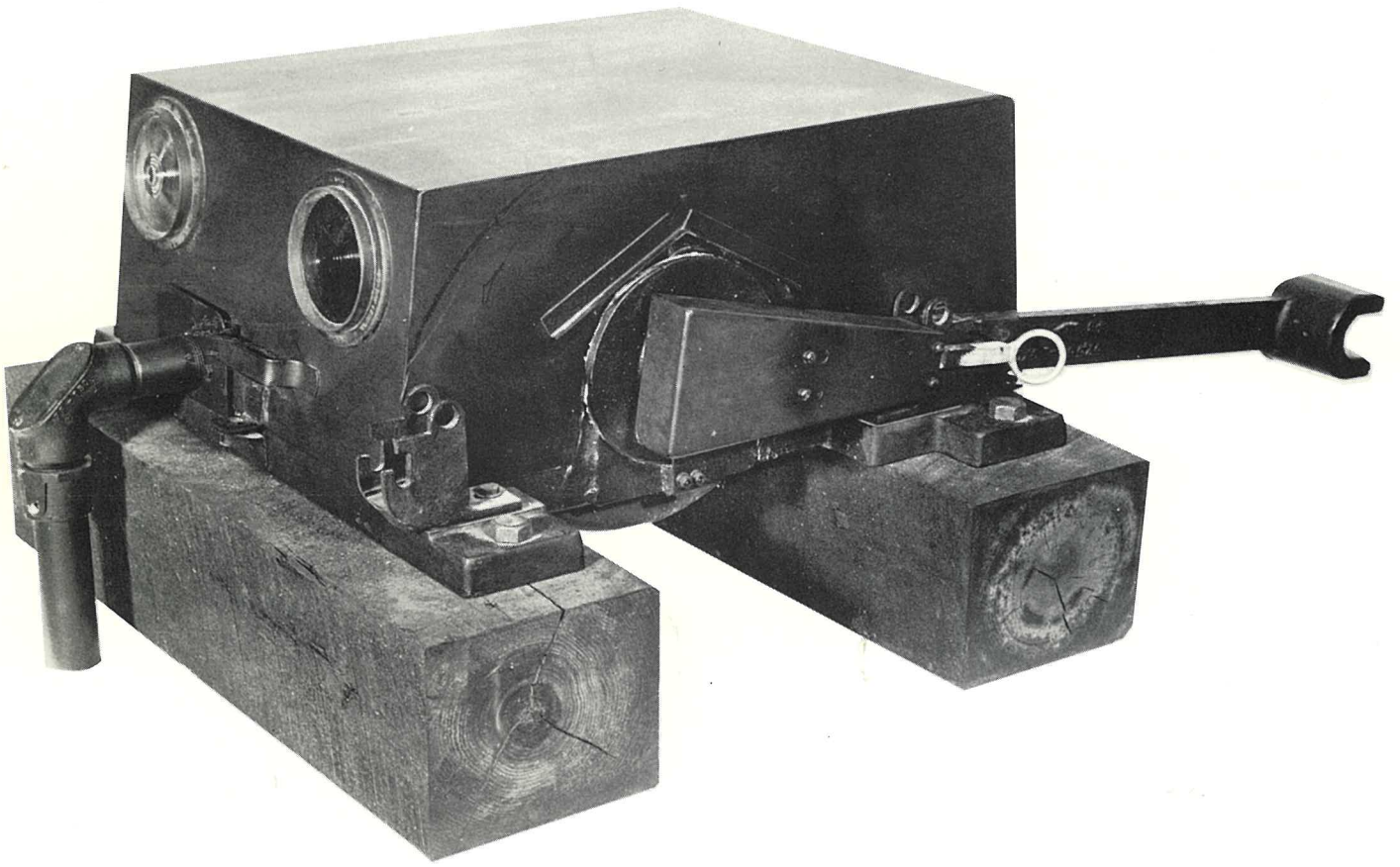
GRS CATALOG **85-4**

GRS



FEATURES

- Designed for receiving, departure, and industrial yards.
- Dual control built-in hand-throw lever, power operation with 115 or 230 volts a-c.
- Reversible in midstroke instantly, in either direction.
- Internal contacts to indicate position remotely.
- Fast operation well under one second.



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DESCRIPTION

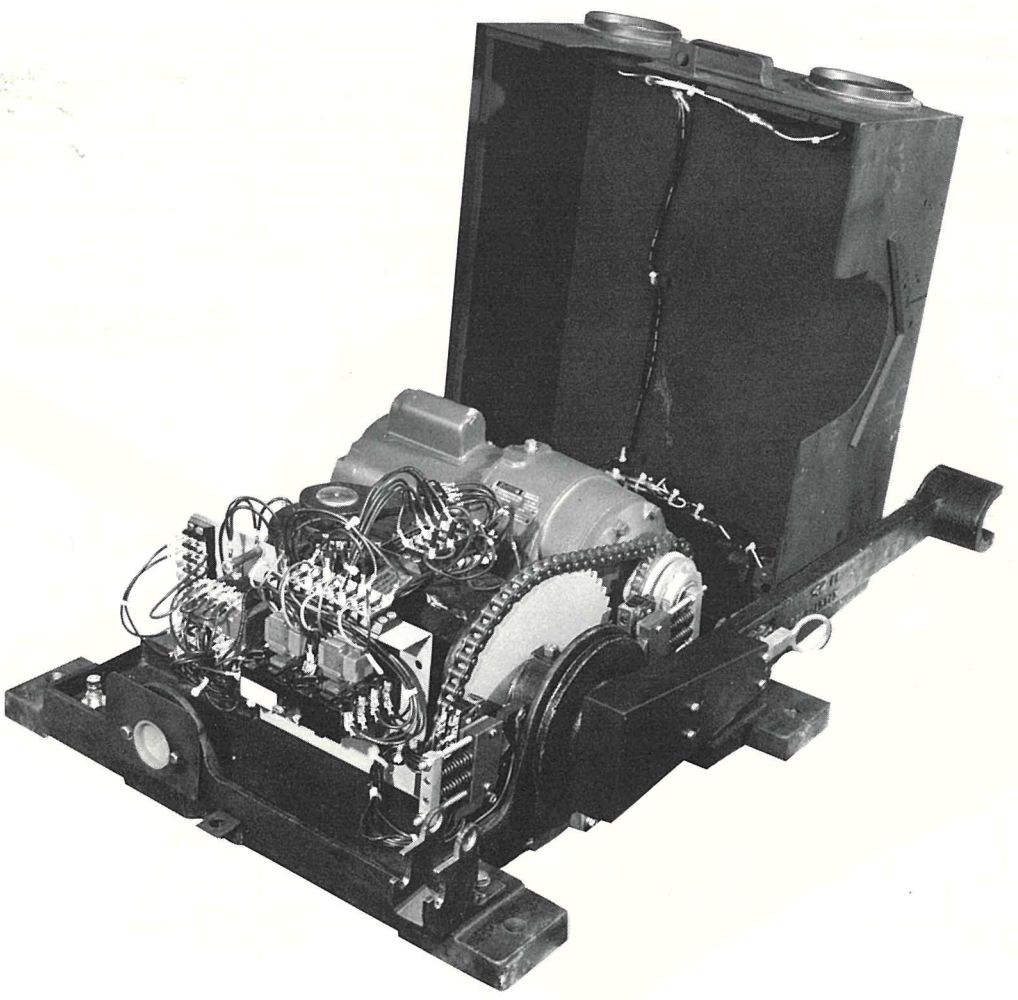
The GRS Speed-Frater is a simplified, compact electric switch machine—less than a foot above tie level. It has every feature needed to speed operations—and to cut costs—in switching areas, such as flat classification yards, receiving and departure yards, and industrial yards. It may also be used to operate derails and blue-flagging devices.

The Speed-Frater is fast—operating time is well under one second from the time of closing of the control circuit to the receipt of indication. Built to fit practically any yard switch, the machine has an easily adjustable throw, from 4½ inches up to a full 5½ inches.

The "open-access" design of the Speed-Frater makes inspection and maintenance quick and easy. With the cover off, all parts are easy to get at. Removing an interior cover, held by two bolts, exposes the throw rod connection for convenient adjustment.

The Speed-Frater is dual control—hand or power operation. It is reversible in midstroke (except when supplied with original automatic restoration) and, in an emergency, can be trailed in either direction.

The Speed-Frater is controlled and operates from a 115-volt, 60-Hz, single-phase power source, drawing approximately 12 amperes. By simple wire changes, which can be made in the field, the machine can be controlled and operated on 230 volts, a-c, at approximately 6 amperes.



The machine has internal contacts for an independent circuit to repeat its position remotely. The indication contacts are electrically isolated from the control and operating circuits.

The Speed-Frater is available in four combinations: the basic machine, with indicator lights, with an automatic restoration feature, or with both. Ordering information is given on page 10.

Basic Speed-Frater

The basic Speed-Frater, as just described, is recommended for installations without track circuits, where debris or ballast is unlikely to block the switch points, and the switch will not be thrown with a train on or approaching it.

The basic Speed-Frater is used with the Generail™ remote control system described later in this catalog.

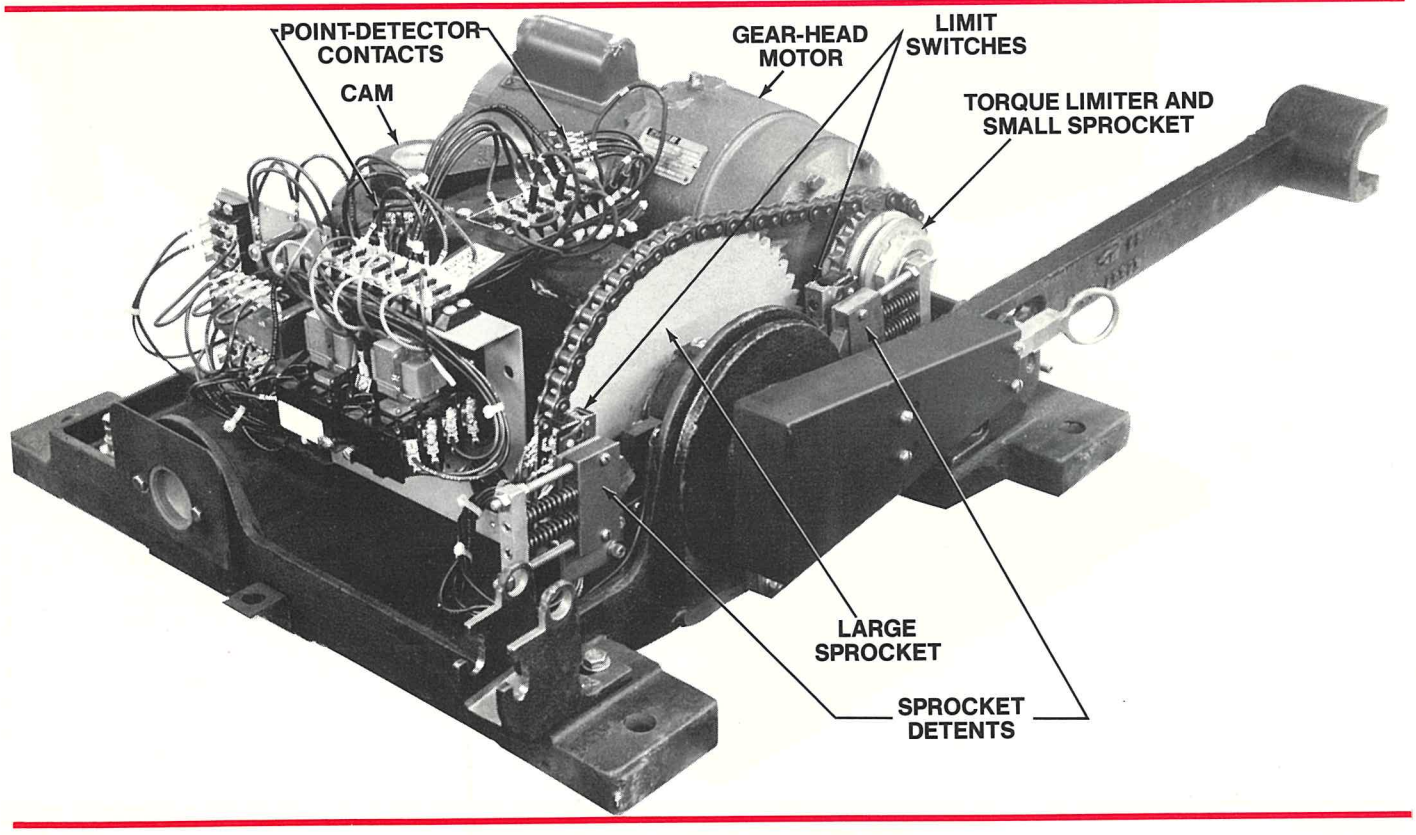
With Automatic Restoration

The Speed-Frater is available with automatic restoration, a feature which causes the machine to reverse should the switch points fail to close due to an obstruction. A neutral relay, with a resistor/capacitor timing network, restores the machine to its starting position if it does not complete its stroke in either direction before the relay has time to release. Machines equipped with optional automatic restoration are not reversible in midstroke.

Detector track circuits are recommended for installations using the Speed-Frater equipped with automatic restoration. A detector track circuit prevents throwing the switch under a train or locomotive—it should extend far enough in advance of the switch points to permit complete switch movement before the leading wheels of the train reach the points, and should be long enough to prevent equipment of the longest wheel base from spanning the circuit.

With Indicator Lights

The Speed-Frater is available with optional self-contained switch position indicator lights. Two indicators, one with a green lens and the other with a yellow lens, are built into each end of the deep-sided cover. The indicators have impact-resistant acrylic lenses which are angled slightly upward for good visibility.



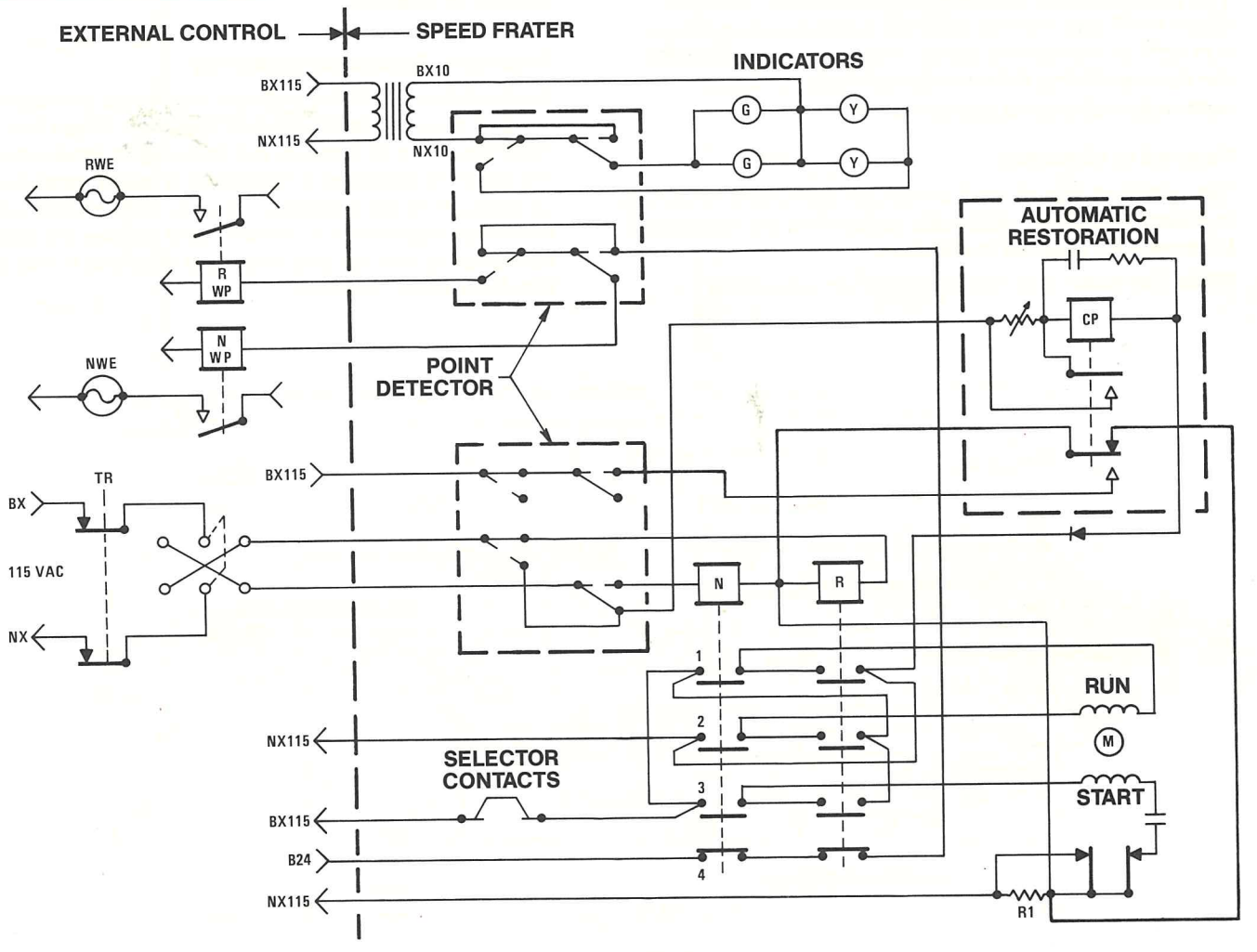
The simplified circuit shows the Speed-Frater controlled remotely by a reversing switch; the circuit also shows optional automatic restoration.

The single-phase motor has a start winding and a run winding. Both are energized for starting the motor to produce the required torque. A capacitor, connected in series with the start winding, produces the required phase shift to initiate armature rotation. When the motor reaches a predetermined speed, a built-in centrifugal switch opens the start winding, and the motor continues to operate on the run winding only.

An adjustable overload torque limiter and sprocket are fastened to the output shaft of the gear-head motor. A chain connects this smaller sprocket to a larger sprocket, which is spline-connected to the horizontal crank (see illustration on page 4).

Before the large sprocket reaches the end of its travel, a cross pin in the sprocket actuates a limit switch, which deenergizes the normal or reverse contactor.

Dropping of the contactor opens the motor circuit and applies energy to the point detector circuit. The cross pin then comes up against a positive stop, and the torque limiter slips slightly to allow the motor to come to a smooth stop.



A cam, mounted on the upper end of the vertical shaft, actuates the adjustable point-detector contacts, which are used for indication purposes.

Whenever the hand-throw lever is below the horizontal in the lowest part of either lever stand, the hand-throw contacts are closed and the Speed-Frater can be operated by power controlled through two mechanically interlocked contactors R and N.

The initiation of a normal or reverse control, by positioning the control switch, applies energy to the corresponding contactor. The contactor picks up to energize the motor and remains up until opened by its sprocket contact during a normal operating cycle.

The point-detector contacts operate position repeater relays NWP and RWP to light the corresponding indication light on the control panel. These contacts also light the corresponding yellow or green indicator lights (optional) in the cover of the machine.

Reversal In Midstroke

The common side of each contactor and the motor circuit in machines without automatic restoration are connected to provide for reversal in midstroke.

When the motor is at rest, the common side of the contactor circuit is connected to energy through the motor start switch. When the motor is running, with the start switch open, resistor R1 is connected in series with the common side. The value of this resistor is such that the energized contactor receives enough energy to remain picked up, but the energy is too low to pick up either contactor once it is released. The contactors must receive initial energy through contacts of the motor start switch.

If the control lever is reversed, the contactor that was picked up releases, but the contactor called for does not pick up until the motor slows down enough to let the start switch close, at which time the motor receives energy to reverse its direction.

Automatic Restoration (Optional)

Restoration relay CP is normally energized through a contact on one of the sprocket switches. When the machine starts to operate, the relay stick circuit opens. If the machine operates in its normal time, CP remains held up through its slow-release network. If the machine takes too long to operate, CP releases and causes the opposite contactor to pick up and return the machine to the position from which it started.

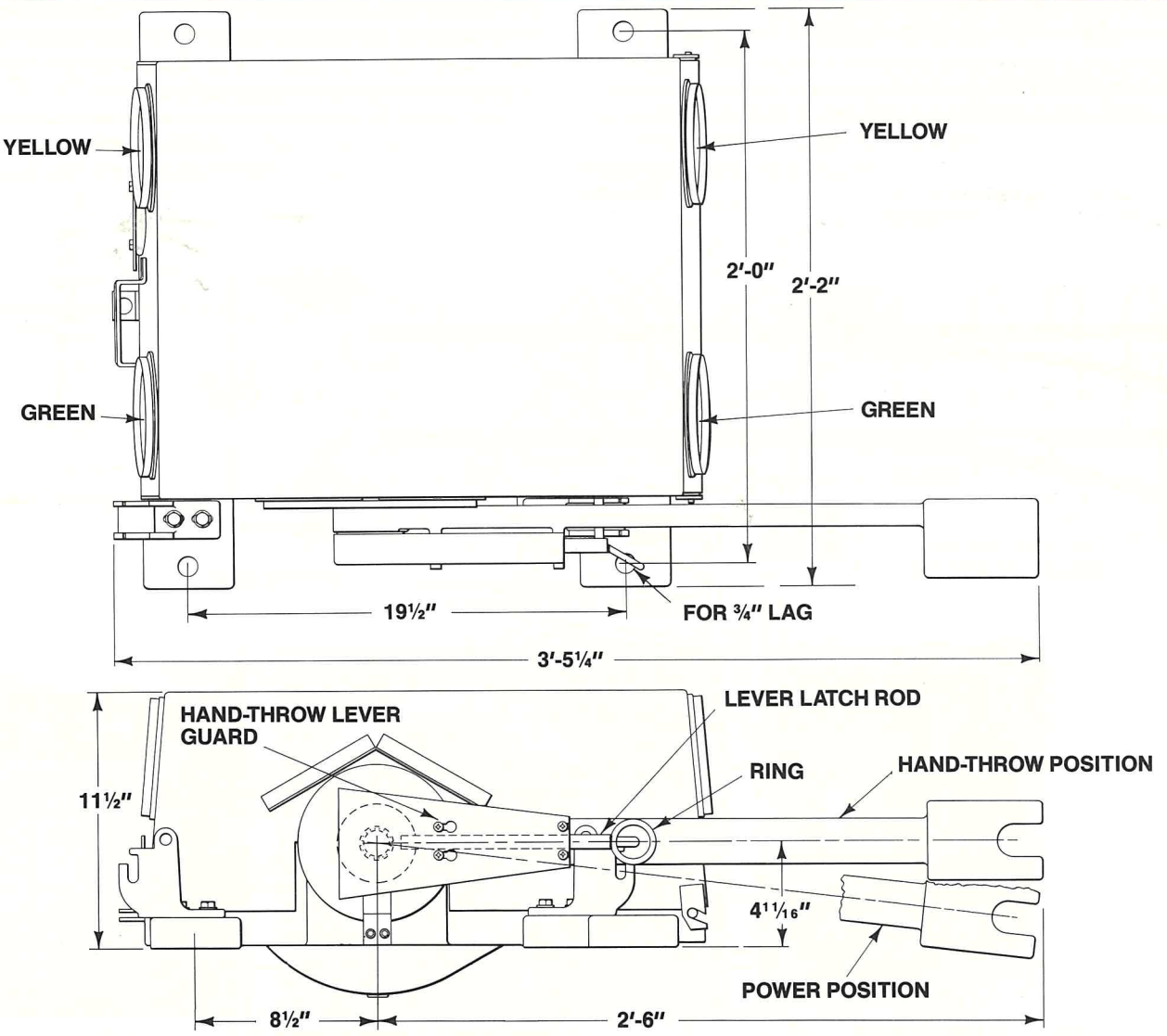
HAND OPERATION

In hand operation, the initial movement of raising the lever from either stand opens the motor circuit and prevents power operation.

The ring on the outside of the lever latch rod is then pulled toward the handle of the lever, while the lever is raised to a horizontal position. Releasing the ring allows the latch rod to engage in the bearing slot, and the switch may be thrown.

The Speed-Frater is returned to power operation by pulling the ring (when the hand-throw lever is horizontal) and allowing the lever to drop down in the stand. Releasing the ring lets the lever drop to its lowest point in the stand, closing the motor circuit.

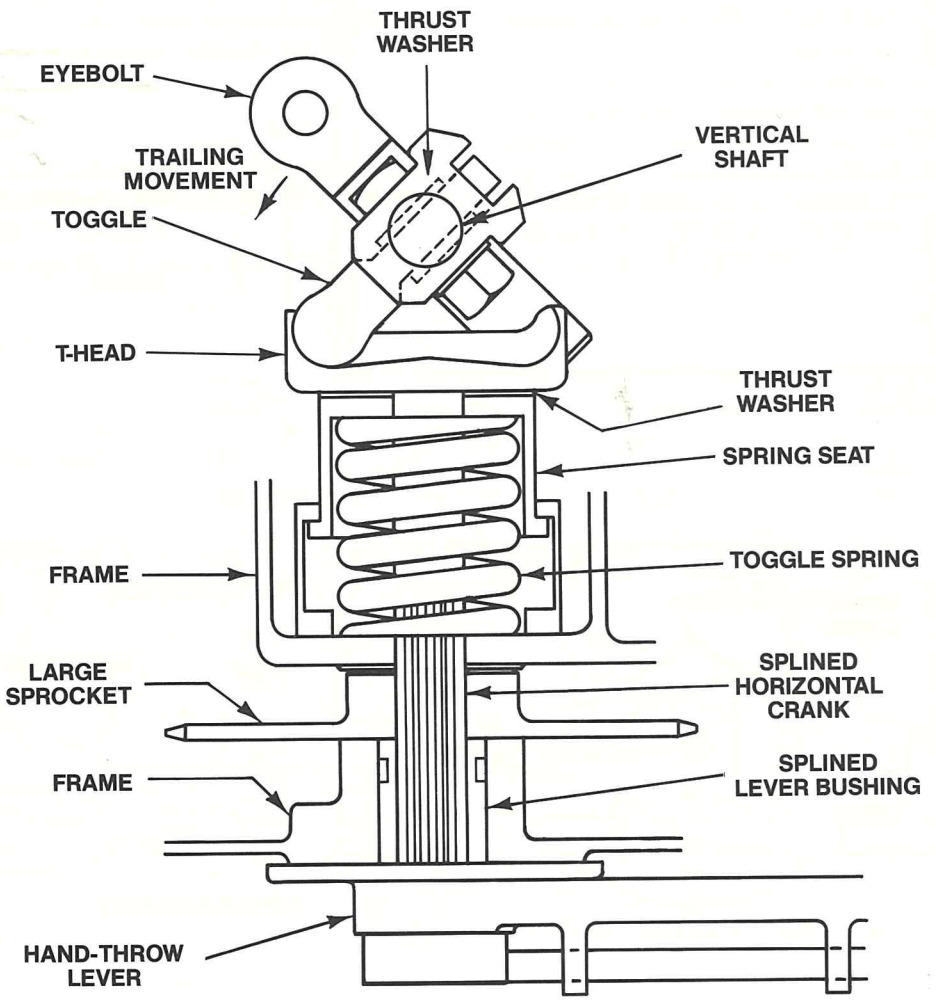
The hand-throw lever release is designed to guard against the possibility of the switch operator restoring the lever into either stand when the switch is neither fully normal nor reverse.



The horizontal crank (see below) is splined to the large sprocket and hand-throw lever bushing. The toggle spring surrounding the crank exerts pressure against the spring seat which, in turn, presses against the T-head on the end of the crank. The oblong T-head has a cavity which engages with the toggle hinged to the vertical shaft. The toggle is held tightly in the cavity by the trapped toggle spring.

In a trailing move through the switch, the throw rod eyebolt and the toggle are moved in a counterclockwise direction. The toggle rides the cavity of the T-head, goes over the crest of the incline, and snaps to the other end of the cavity, thus completing the switch throw in the opposite direction. The T-head does not rotate in this operation, but simply moves under spring pressure as required without disturbing the position of any other part, due to the splined design of the horizontal crank. **NOTE: Trailing operation, except in an emergency, is not advisable; the resulting forces can cause excessive wear.**

In hand or power operation, the horizontal crank is turned 180° (½ turn) and the vertical shaft 90° (¼ turn). The toggle is held by spring pressure in one end of the T-head cavity and moves with the T-head as it turns to the opposite position, thus throwing the switch. The sprocket and lever bushing are splined to the horizontal movement. In hand operation, the latch rod on the hand-throw lever engages in a slot in the lever bushing.



REMOTE CONTROL

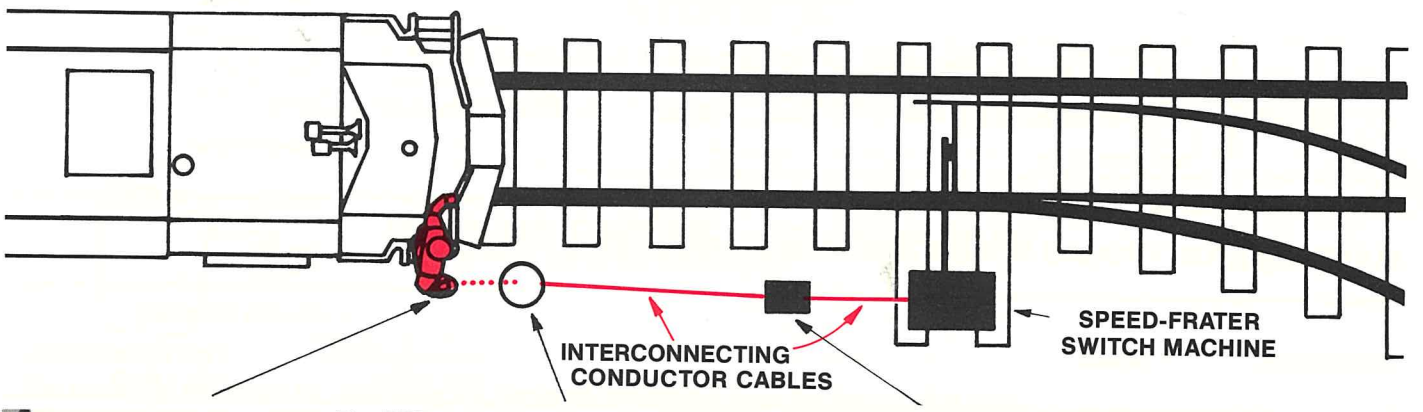
The Generail remote control system can greatly expand the usefulness and efficiency of the Speed-Frater electric switch machine. Also, Generail remote control is a simple, economical way to provide for remote operation of any two-position device (on-off, normal-reverse, etc.).

The Generail system consists of a battery-operated portable transmitter, an inert encapsulated wayside receiving coil, and a solid-state control box.

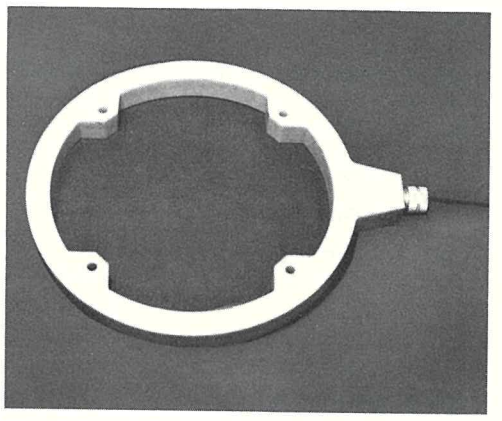
As a train approaches the switch location, the trainman operates the normal-reverse rocker switch on his belt-carried transmitter (which may also be hung outside the locomotive and operated via a cable and control box from within the cab). The resultant output signal, detected by the wayside receiving coil (located within 12 feet of the transmitter), is sent via cable to the control module associated with the Speed-Frater. The switch machine responds instantly to operate the switch to the called-for position.

Features of Generail remote control of the Speed-Frater include:

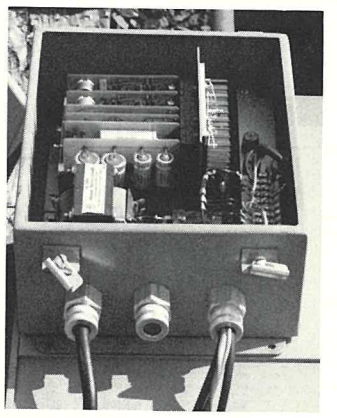
- Substantial savings because of smaller crew requirements.
- Control of a switch machine from a moving train or from the ground.
- Speeds operations in the switching area.
- Choice of control module location—on the ties near the Speed-Frater, in a nearby wayside housing, or at a remote location.
- The receiving coil can be located up to 400 feet ahead of the track switch. It requires no maintenance. Additional coils may be used as required.
- No FCC licensing is required.



Portable transmitter.

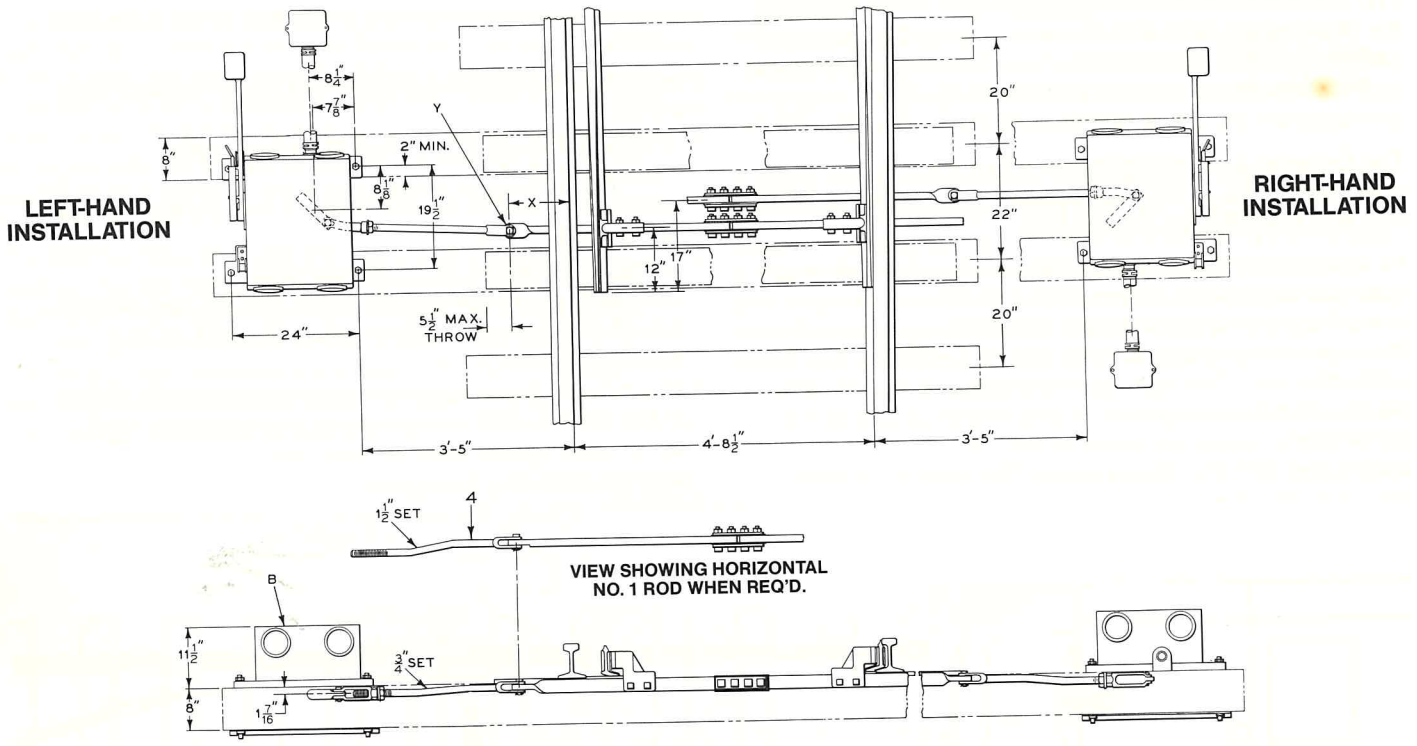


Receiving coil, 10¾″ mounting centers.



Control box, cover off, 8″ x 12¾″ mounting centers.

SPEED-FRATER
ORDERING INFORMATION

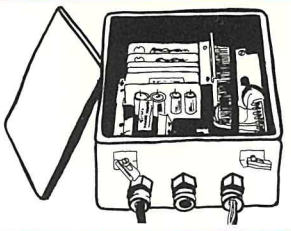


PLEASE ORDER BY CATALOG NUMBER AND NAME SHOWN IN BOLD TYPE.

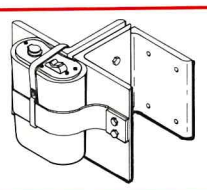
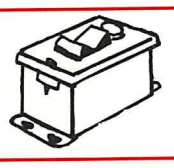
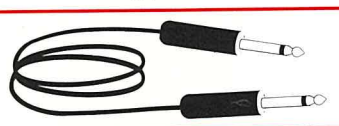
REFERENCE	NAME	CATALOG NUMBER FOR VERTICAL NO. 1 ROD	CATALOG NUMBER FOR HORIZONTAL NO. 1 ROD
A	**SPEED-FRATER LAYOUT COMPLETE,** with basic machine, terminal box and necessary rods and fittings for connection to No. 1 rod (No. 1 rod not included) Order must specify dim. X and hole size Y	A85-980	A85-981
A1	As above, except plus automatic restoration	A85-982	A85-983
A2	Same as Ref. A, except plus indicator lights	A85-984	A85-985
A3	Same as Ref. A, except plus automatic restoration and indicator lights	A85-986	A85-987
B	**SPEED-FRATER,** only	A85-988	
B1	Same as Ref. B, except plus automatic restoration	A85-989	
B2	Same as Ref. B, except plus indicator lights	A85-990	
B3	Same as Ref. B, except plus automatic restoration and indicator lights	A85-991	

GENERAIL REMOTE CONTROL ORDERING INFORMATION

PLEASE ORDER BY CATALOG NUMBER AND NAME SHOWN IN BOLD TYPE.

	NAME	CATALOG NUMBER
	**CONTROL BOX COMPLETE**	A85-1000
	RECEIVING COIL COMPLETE, includes squeeze connector for cable from control box.	A85-1005
	CABLE, shielded, two-conductor No. 18, with heavy-duty neoprene jacket (Belden No. 8428 or equivalent), for use between receiving coil and control box. Specify number of feet required.	P85-1200
	CABLE, nonshielded, five-conductor No. 16, for use between control box and Speed-Frater. Specify number of feet required.	P85-1203
	TRANSMITTER COMPLETE, portable, includes belt and two batteries *(shipped separately).	A85-1003

The following items are for operating the Generail transmitter from the locomotive cab.

	**TRANSMITTER MOUNTING BRACKET,** for use where it is desired to fasten transmitter to side of locomotive so transmitter can be controlled from cab, using locomotive control box and cord complete, items listed below.	A85-1008
	**LOCOMOTIVE CONTROL BOX,** includes two batteries* (shipped separately).	A85-1007
	**CORD COMPLETE,** with two plug connectors, for connection between locomotive control box and transmitter; approximately 12 feet long.	P85-1205

*12.6-volt, mercury primary cells (Mallory TR 289, Burgess H289, or Eveready E289).

GENERAL RAILWAY SIGNAL
A UNIT OF GENERAL SIGNAL

MAIN OFFICE AND PLANT
BOX 600 ROCHESTER NY 14692 Phone: 716 • 436-2020 Cable: GENRASIG (ROCHESTER NY)
Telex: 978317

ATLANTA OFFICE
3379 PEACHTREE ROAD NE ATLANTA GA 30326 Phone: 404 • 233-7373

CHICAGO OFFICE
SUITE 2120 PRUDENTIAL PLAZA CHICAGO IL 60601 Phone: 312 • 467-1221

MONTREAL OFFICE
POINTE-CLAIRE COMMERCE CENTER 6600 TRANSCANADA HIGHWAY POINTE-CLAIRE QUEBEC H9R 4S2
Phone: 514 • 694-7350

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ROOM 928 230 PARK AVENUE NEW YORK NY 10169 Phone: 212 • 697-3681

OAKLAND OFFICE
FIRST INTERSTATE BANK OF CALIFORNIA BUILDING SUITE 1440 1330 BROADWAY OAKLAND CA 94612
Phone: 415 • 893-3100

ST. LOUIS OFFICE
LACLEDE GAS BUILDING 720 OLIVE STREET ST. LOUIS MO 63101
Phone: 314 • 621-4696

ST. PAUL OFFICE
NORTHWESTERN NATIONAL BANK BUILDING SUITE 1380 55 E 5TH STREET ST. PAUL MN 55101
Phone: 612 • 277-9268

WASHINGTON OFFICE
MONTGOMERY CENTER SUITE 613 8630 FENTON STREET SILVER SPRING MD 20910
Phone: 301 • 587-4770

GRS INTERNATIONAL

MAIN OFFICE:
BOX 600 ROCHESTER NEW YORK U.S.A. 14692 Phone: 716 • 436-2020
Cable: GENRASIG (ROCHESTER NY) Telex: 978317

G.R.S. TRADING CORPORATION:
BOX 600 ROCHESTER NEW YORK U.S.A. 14692 Phone: 716 • 436-2020
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GEC-GENERAL SIGNAL LIMITED
ELSTREE WAY BOREHAMWOOD HERTFORDSHIRE WD6 1RX ENGLAND Phone: 01-953-8211
Cable: RAILSIGKO BOREHAMWOOD (ENGLAND) Telex: 22777 GECBWD G BOREHAMWOOD (ENGLAND)

ALGEMENE SEIN INDUSTRIE B.V.
CROESELAAN 28 3521 CB UTRECHT NETHERLANDS Phone: (030) 94 26 46
Cable: GENRASIG UTRECHT (NETHERLANDS) Telex: 47455 GRASI NL UTRECHT (NETHERLANDS)

REPRESENTATIVES AND LICENSEES THROUGHOUT THE WORLD.

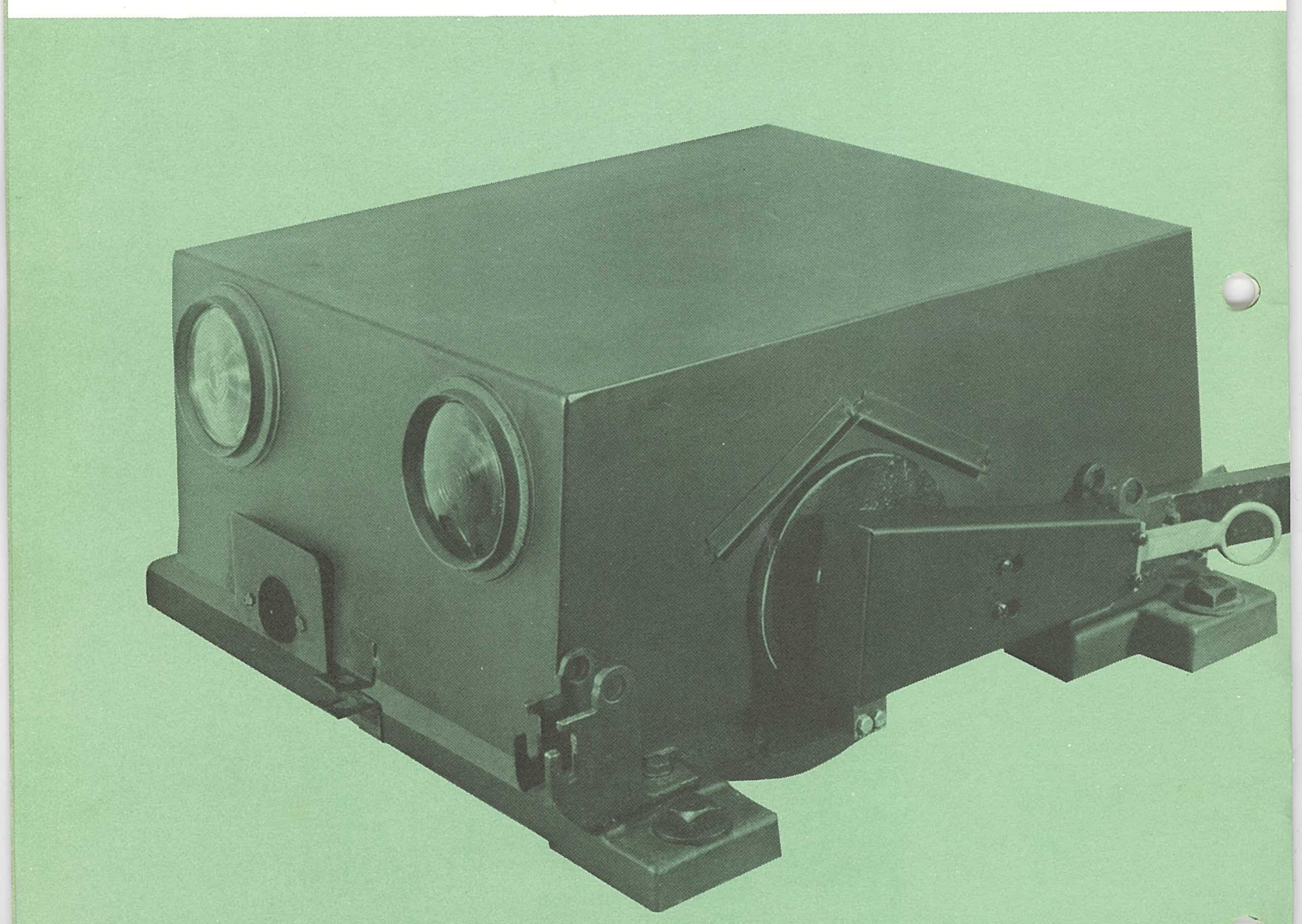
GRS CATALOG 85-4

SPEED-FRATER™
ELECTRIC SWITCH MACHINE

- Every feature needed for efficient, economical switching.
- Available with wireless remote control — man-portable or from locomotive.

For ordering information — see pages 11 and 12.

GENERAL RAILWAY SIGNAL COMPANY
A UNIT OF GENERAL SIGNAL
ROCHESTER NEW YORK 14602



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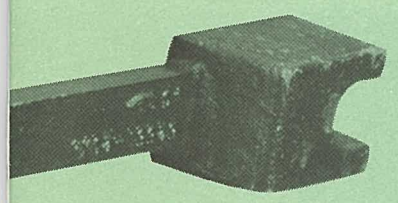


STANDARD FEATURES

DESIGNED SPECIFICALLY for— receiving, departure, and industrial yards.

TRAILABLE— in either direction, with full point pressure of over 1,000 pounds.

DUAL CONTROL— built-in hand-throw lever, power operation with 115 or 230 volts a-c.

REVERSIBLE IN MIDSTROKE— instantly, in either direction.

INTERNAL CONTACTS— to indicate position remotely.

FAST OPERATION— well under one second.

OPTIONAL FEATURES

AUTOMATIC RESTORATION— returns to closed-point position if obstructed.

INDICATOR LIGHTS— built into each end of the deep-sided cover.

DESCRIPTION

The GRS Speed-Frater is a simplified, compact electric switch machine — less than a foot above tie level. It has every feature needed to speed operations — and to cut costs — in switching areas, such as flat classification yards, receiving and departure yards, and industrial yards. It may also be used to operate derails and blue-flagging devices.

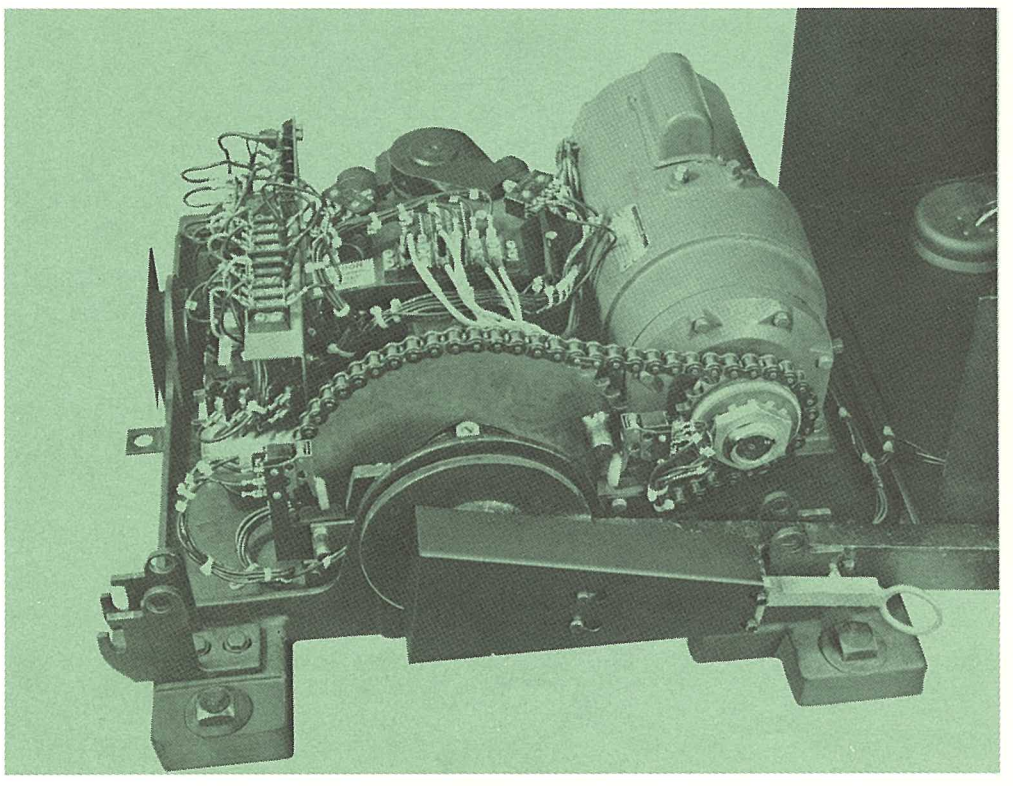
The Speed-Frater is fast — operating time is well under one second from the time of closing of the control circuit to receipt of indication. Built to fit practically any yard switch, the machine has an easily adjustable throw, up to a full 5 ½ inches.

The "open-access" design of the Speed-Frater makes inspection and maintenance quick and easy. With the cover off, all parts are easy to get at. Removing an interior cover, held by two bolts, exposes the throw rod connection for convenient adjustment.

The Speed-Frater is available in four combinations: the basic machine, with indicator lights, with automatic restoration feature, or with both. Ordering information is given on page 11.

BASIC SPEED-FRATER

The basic machine is dual control — hand or power operation. It can be trailed in either direction, with full point pressure of over 1000 pounds, without damage to the machine, switch points, or fittings, and is reversible in midstroke.



Speed-Frater with cover open.

As supplied, the Speed-Frater is controlled and operates from a 115-volt, 60 Hz, single phase a-c power source, drawing approximately 12 amperes. By simple wire changes, which can be made in the field, the machine can be controlled and operated on 230 volts, at approximately 6 amperes.

The basic machine also includes internal contacts for an independent circuit to repeat its position remotely. The indication contacts are electrically isolated from the control and operating circuits.

WITH INDICATOR LIGHTS

Self-contained switch position indicators can be provided with the basic machine described. A signal having a green lens and a yellow lens is built into each end of the deep-sided cover. The lenses are angled slightly upward for good visibility.

WITH AUTOMATIC RESTORATION

Another option is automatic restoration of position if the machine is prevented from completing its stroke. A neutral relay with a timing network operates to restore the machine to its starting position if, for any reason, it does not complete its stroke in either direction before the relay has time to release.

COMPLETE SPEED-FRATER

This combination includes the basic machine equipped with the automatic restoration feature and indicator lights, described above.

INSTALLATION

The Speed-Frater mounts directly on two unframed ties, in either a left-hand or right-hand layout, and on the open or closed point side.

The throw of the Speed-Frater is adjustable to a maximum of 5 ½ inches. The eyebolt of the machine connects to the throw rod. The No. 1 rod of the switch connects to the opposite end of the throw rod. Turning the eyebolt adjusts the switch machine throw to the throw of the switch — one full turn equals about 3/32 inch change in horizontal adjustment.

Detector track circuits are recommended to prevent throwing a switch under a car or locomotive. The track circuit should extend far enough in advance of the switch points to permit completion of switch movement before the leading car wheels reach the points. The circuit should be long enough to prevent equipment of the longest wheel base from spanning the circuit.

POWER OPERATION

The single-phase motor has a start winding and a run winding. Both are energized for starting the motor to produce the required torque. A capacitor, located on top of the motor and connected in series with the start winding, produces the required phase shift to initiate armature rotation. When the motor reaches a predetermined speed, a built-in centrifugal switch opens the start winding, and the motor continues to operate on the run winding only.

An adjustable overload torque limiter and sprocket are fastened to the output shaft of the gear-head motor. A chain connects this smaller sprocket to a larger sprocket, which is spline-connected to the horizontal crank (see illustration on page 9).

Before the large sprocket reaches the end of its travel, a cross pin in the sprocket actuates a limit switch, which deenergizes the contactor and also closes the contacts used in the correspondence circuits. Dropping of the contactor opens the motor circuit. The cross pin then comes up against a positive stop, and the torque limiter slips slightly to allow the motor to come to a smooth stop.

A cam, mounted on the upper end of the vertical shaft, actuates the adjustable point-detector contacts, which are used for indication purposes.

One simplified circuit shows the Speed-Frater controlled remotely by a three-position lever. Right and left positions of the lever are for normal and reverse control, while the center position is used to pick up restoration relay CP. The other circuit shows how the Speed-Frater can be controlled from a pushbutton. The pushbutton operates one of a pair of Type J magnetic-stick relays when pushed, and thereby picks up the CP, if released on a prior operation. Release of the pushbutton operates the second relay to cause a machine operation, if the CP was not released due to a prior obstruction. If the CP was released, it is restored and a second push and release of the pushbutton is required for the next operation.

Whenever the hand-throw lever is below the horizontal in the lowest part of either lever stand, selector contacts HT are closed and the Speed-Frater can be operated by power. Two mechanically interlocked contactors R and N control the power operation.

The initiation of a normal or reverse control, by positioning the control lever, applies energy to the corresponding contactor. The contactor picks up to energize the motor and remains up until opened by its sprocket contact during a normal operating cycle.

The point-detector contacts operate position repeater relays NWP and RWP to light the corresponding indication light on the control panel. These contacts also light the corresponding yellow or green signals (optional) in the cover of the machine.

REVERSAL in MIDSTROKE

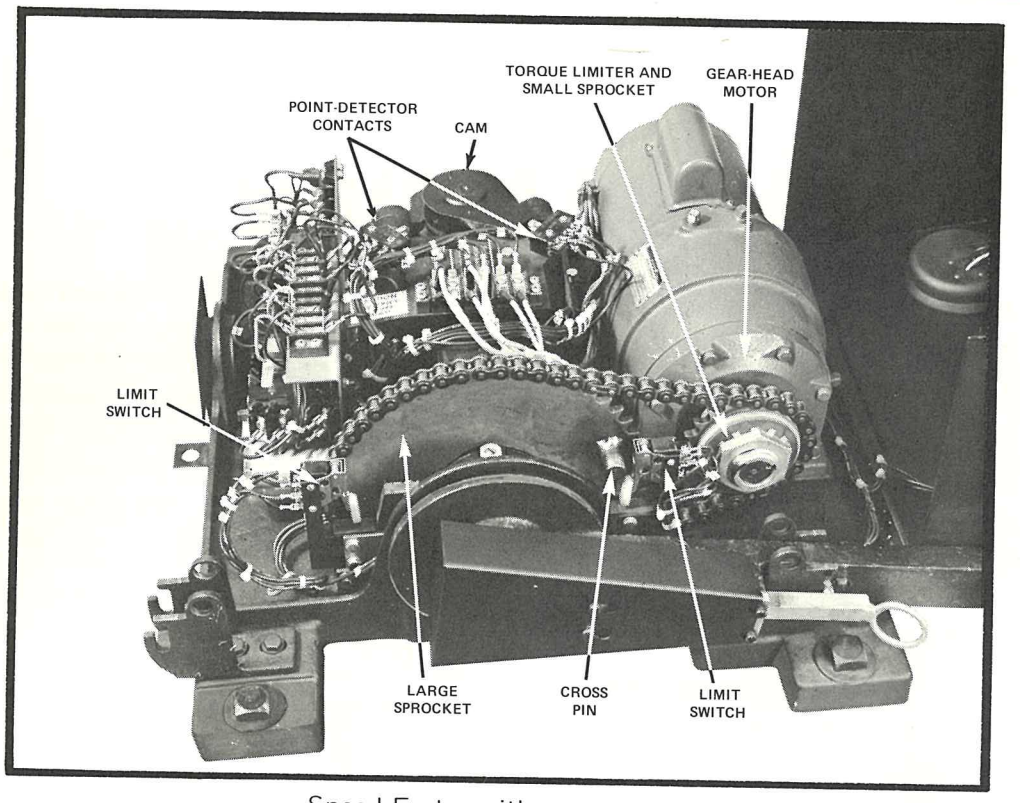
The common side of each contactor and the motor circuit are connected to provide for reversal in midstroke.

When the motor is at rest, the common side of the contactor circuit is connected to energy through contacts of the hand-throw selector switch, a front contact of restoration relay CP, and a contact of the motor start switch. When the motor is running, with the start switch open, resistor R1 is connected in series with the common side. The value of this resistor is such that the energized contactor will receive enough energy to remain picked up, but energy will be too low to pick up either contactor once it is released. The contactors must receive initial energy through contacts of the motor start switch.

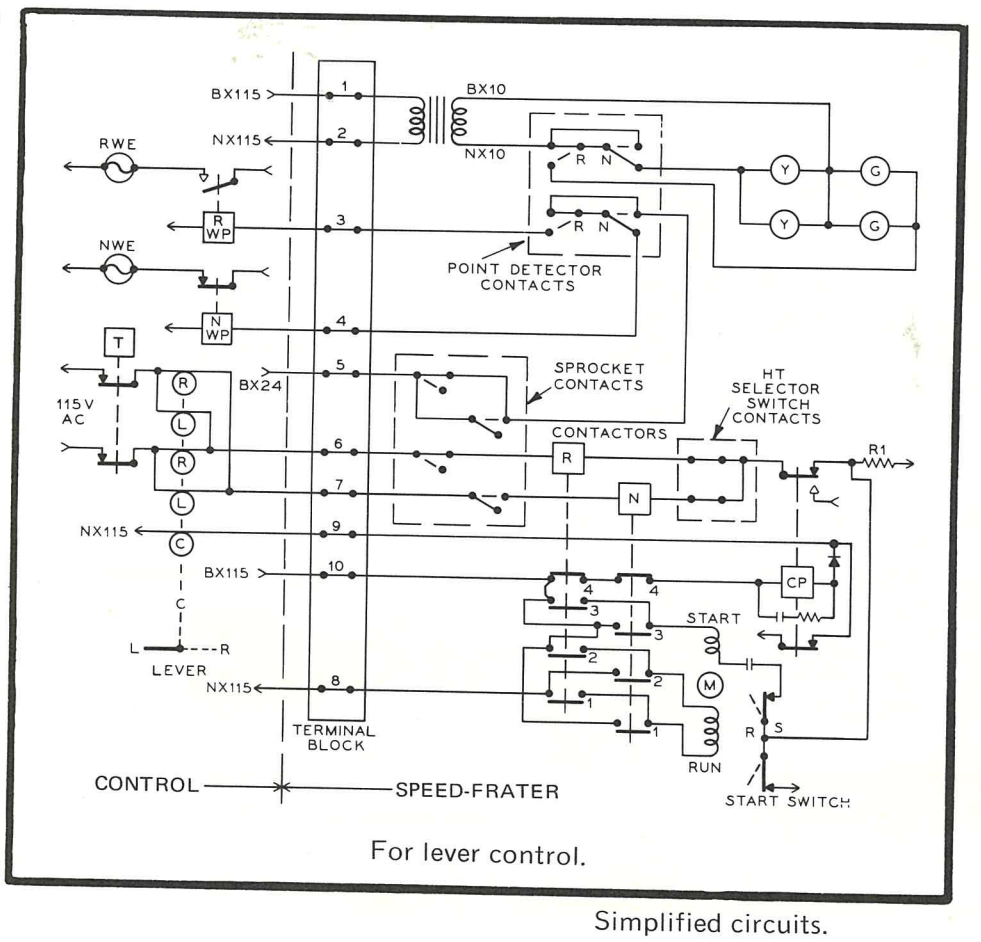
If the control lever is reversed, the contactor that was picked up will release, but the contactor called for will not pick up until the motor slows down enough to let the start switch close, at which time the motor will receive energy to reverse.

AUTOMATIC RESTORATION (Optional)

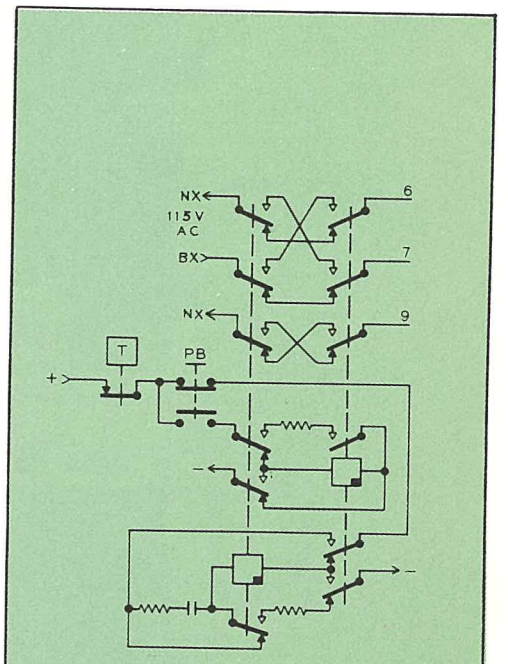
Restoration relay CP is normally energized through a back contact of each contactor in series. When either contactor is energized, the stick circuit of the relay is opened. If the Speed-Frater operates in its normal time, CP will remain held up through its slow-release network. If the machine takes too long to operate, CP will release and cause the opposite contactor to pick up and return the machine to the position from which it started.



Speed-Frater with cover open.



For lever control.



For pushbutton control.

Simplified circuits.

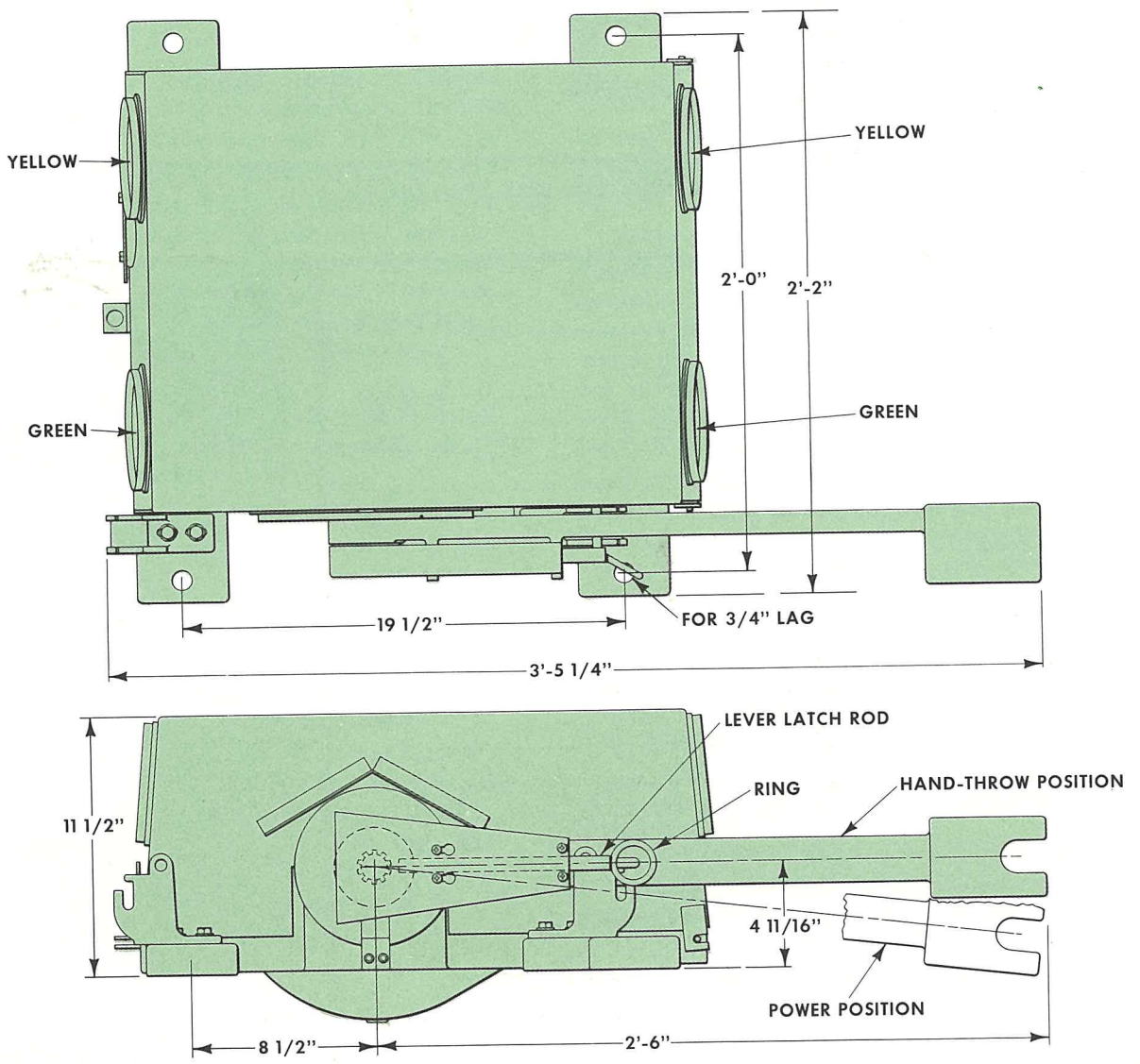
HAND OPERATION

In hand operation, the initial movement of raising the lever from either stand opens the motor circuit and prevents power operation.

The ring on the outside of the lever latch rod is then pulled toward the handle of the lever, while the lever is raised to a horizontal position. Releasing the ring allows the latch rod to engage in the bearing slot, and the switch may be thrown.

The Speed-Frater is returned to power operation by pulling the ring and allowing the lever to drop down in the stand. Releasing the ring lets the lever drop to its lowest point in the stand, closing the motor circuit.

The handthrow lever release is designed to guard against the possibility of the switch operator restoring the handthrow lever into either stand when the switch is neither fully normal nor reverse.



External dimensions and positions of hand-throw lever.

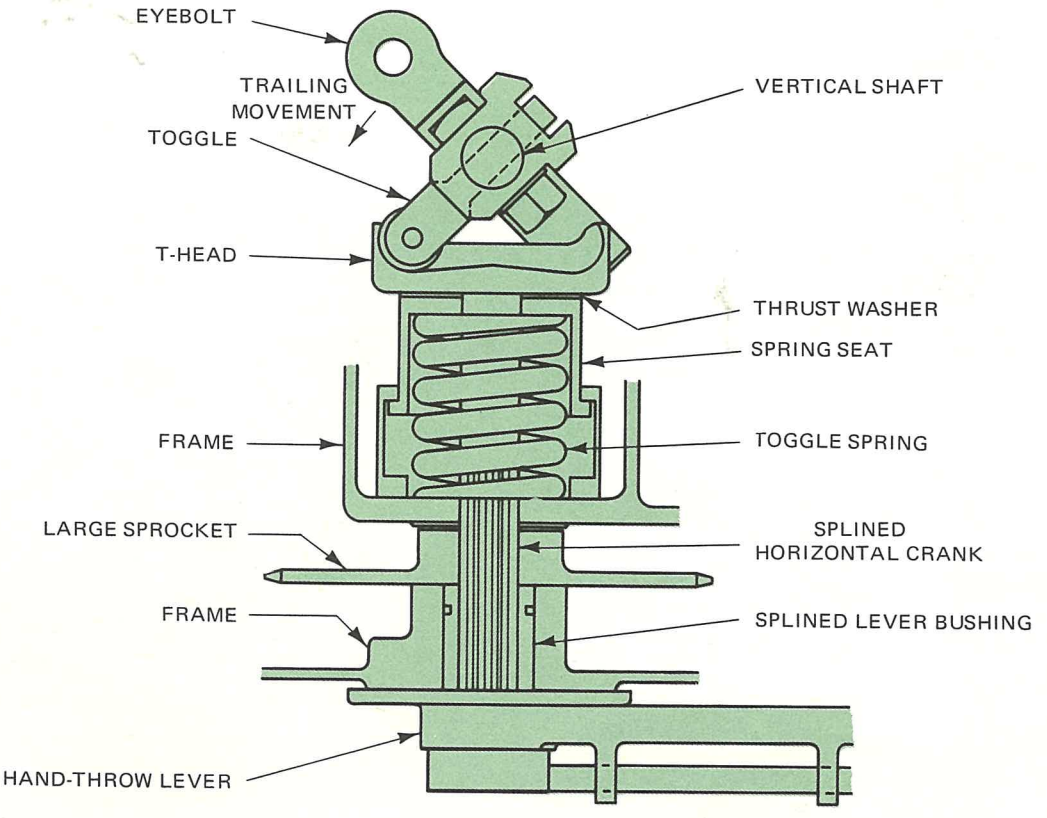
MECHANICAL PRINCIPLES

A toggle spring surrounds the horizontal crank; see below. The other side of the T-head of the crank, opposite from the vertical shaft, rests against an oilite thrust bearing which, in turn, rests against the spring seat.

The horizontal crank has an oblong T-head with a cavity, which engages with the toggle hinged to the vertical shaft. The roller of the toggle is held tightly in the cavity by the trapped toggle spring.

In a trailing move through the switch, the throw rod eyebolt and the toggle are moved in a counter-clockwise direction (in illustration). The roller rides the cavity of the T-head, goes over the crest of the incline, and snaps to the other end of the cavity, thus completing the switch throw in the opposite direction. The T-head does not turn in this operation, but simply moves under spring pressure as required without disturbing the position of any other part, due to the splined design of the horizontal crank.

In hand or power operation, the horizontal crank is turned 180° (½ turn) and the vertical shaft 90° (¼ turn). The toggle is held by spring pressure in one end of the T-head cavity and moves with the T-head as it turns to the opposite position, thus throwing the switch. The sprocket and lever bushing are splined to the horizontal crank, hence are not affected by any horizontal movement. In hand operation, the latch rod on the hand throw lever engages in a slot in the lever bushing.



Relation of toggle and T-head.

REMOTE CONTROL

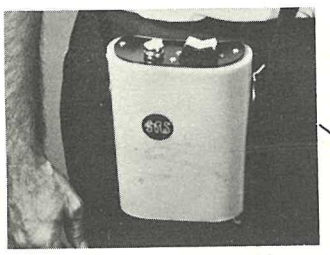
The Generail remote control system can greatly expand the usefulness and efficiency of the Speed-Frater electric switch machine. Also, Generail remote control is a simple, economical way to provide for remote operation of any two-position device (on-off, normal-reverse, etc.).

The Generail system consists of a battery-operated portable transmitter, an inert wayside receiving coil, and a solid-state control box. It can be applied to any Speed-Frater not having automatic restoration.

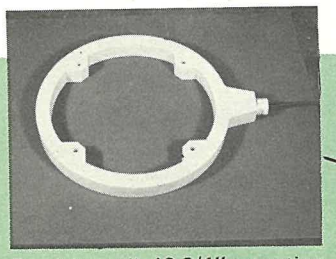
As a train approaches the switch location, the trainman operates the normal-reverse rocker switch on his belt-carried transmitter (which may also be hung outside the locomotive and operated via a cable and control box from within the cab). The resultant output signal, detected by the wayside receiving coil, is sent via cable to the control module associated with the Speed-Frater. The switch machine responds instantly to operate the switch to the called-for position.

Features of Generail remote control of the Speed-Frater include:

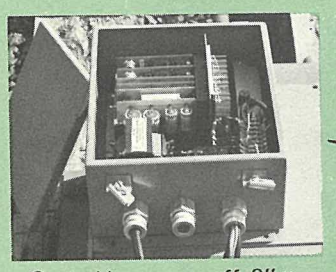
- Substantial savings because of smaller crew requirements.
- A switch may be controlled from a moving train or from the ground.
- Speeds operations in the switching area.
- The control module can be mounted on the ties near the Speed-Frater, in a nearby wayside housing, or at a remote location.
- The encapsulated receiving coil can be located up to 400 feet ahead of the track switch. It requires no maintenance. Additional coils may be used as required.
- No FCC licensing is required.



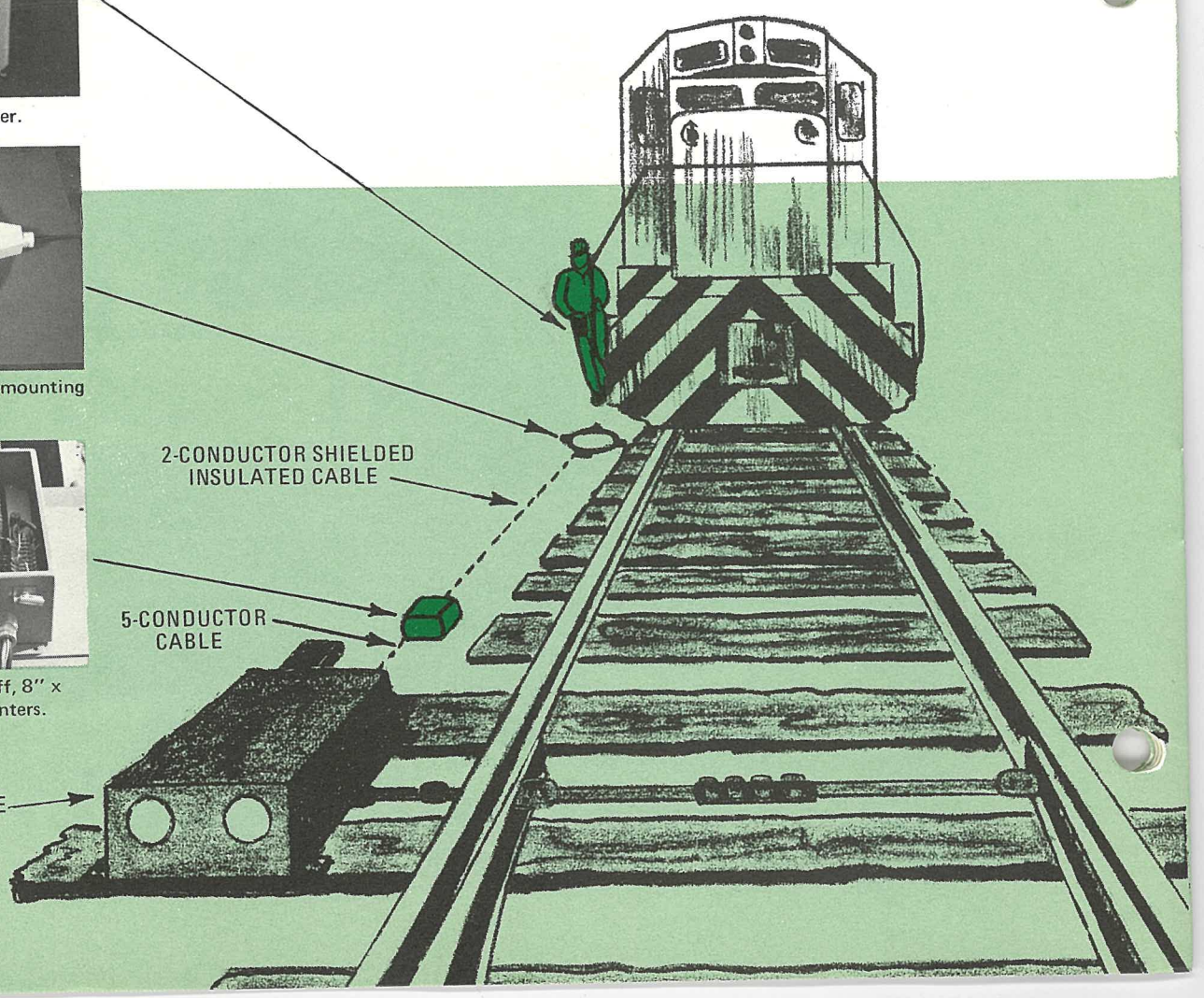
Portable transmitter.



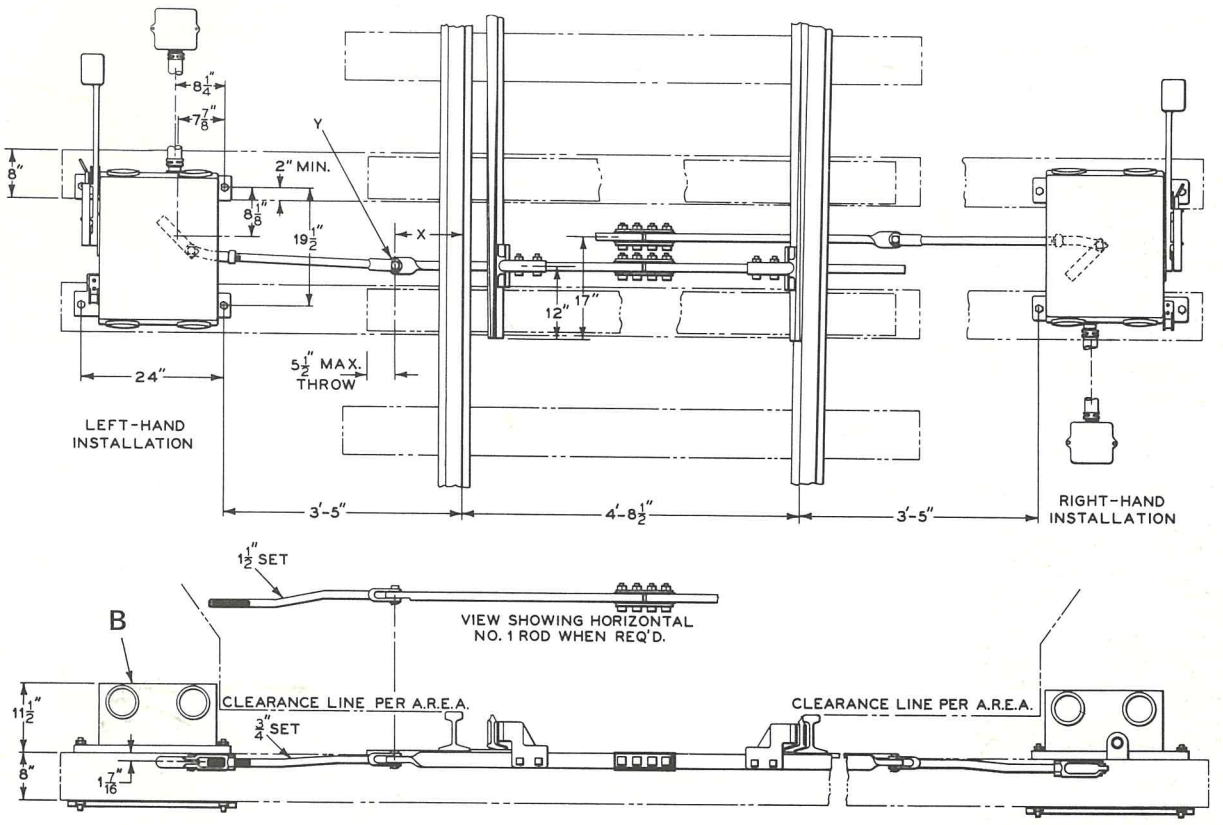
Receiving coil, 10-3/4" mounting centers.



Control box, cover off, 8" x 12-3/4" mounting centers.



SPEED-FRATER ORDERING INFORMATION



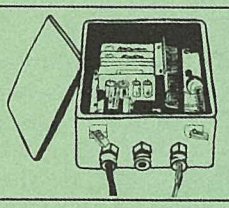
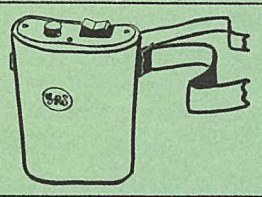
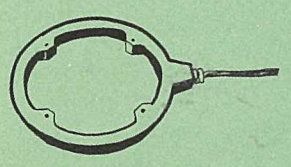
A. Speed-Frater layout, shown with optional indicator lights.

PLEASE ORDER BY CATALOG NUMBER AND NAME SHOWN IN BOLD TYPE.

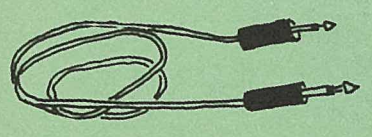
REF.	NAME	CATALOG NUMBER	
		FOR VERTICAL NO. 1 ROD	FOR HORIZONTAL NO. 1 ROD
A	**SPEED-FRATER LAYOUT COMPLETE,** with basic machine, terminal box and necessary rods and fittings for connection to No.1 rod . . . . . Order must specify dim. X and hole size Y	A85-980	A85-981
A1	As above, except plus automatic restoration	A85-982	A85-983
A2	Same as Ref. A, except plus indicator lights	A85-984	A85-985
A3	Same as Ref. A, except plus automatic restoration and indicator lights	A85-986	A85-987
B	**SPEED-FRATER,** only	A85-988	
B1	Same as Ref. B, except plus automatic restoration . . .	A85-989	
B2	Same as Ref. B, except plus indicator lights	A85-990	
B3	Same as Ref. B, except plus automatic restoration and indicator lights	A85-991	

GENERAIL
REMOTE CONTROL ORDERING INFORMATION

PLEASE ORDER BY CATALOG NUMBER AND NAME SHOWN IN BOLD TYPE.

	NAME	CATALOG NO.
	**CONTROL BOX COMPLETE**	A85-1000
	**TRANSMITTER COMPLETE,** portable, includes belt and two batteries * (shipped separately)	A85-1003
	**RECEIVING COIL COMPLETE,** includes squeeze connector for cable from control box	A85-1005
	CABLE, shielded, two-conductor No. 18, with heavy-duty neoprene jacket (Belden No. 8428 or equivalent), for use between receiving coil and control box. Specify number of feet required	P85-1200
	CABLE, nonshielded, five-conductor No. 16, for use between control box and Speed-Frater. Specify number of feet required	P85-1203

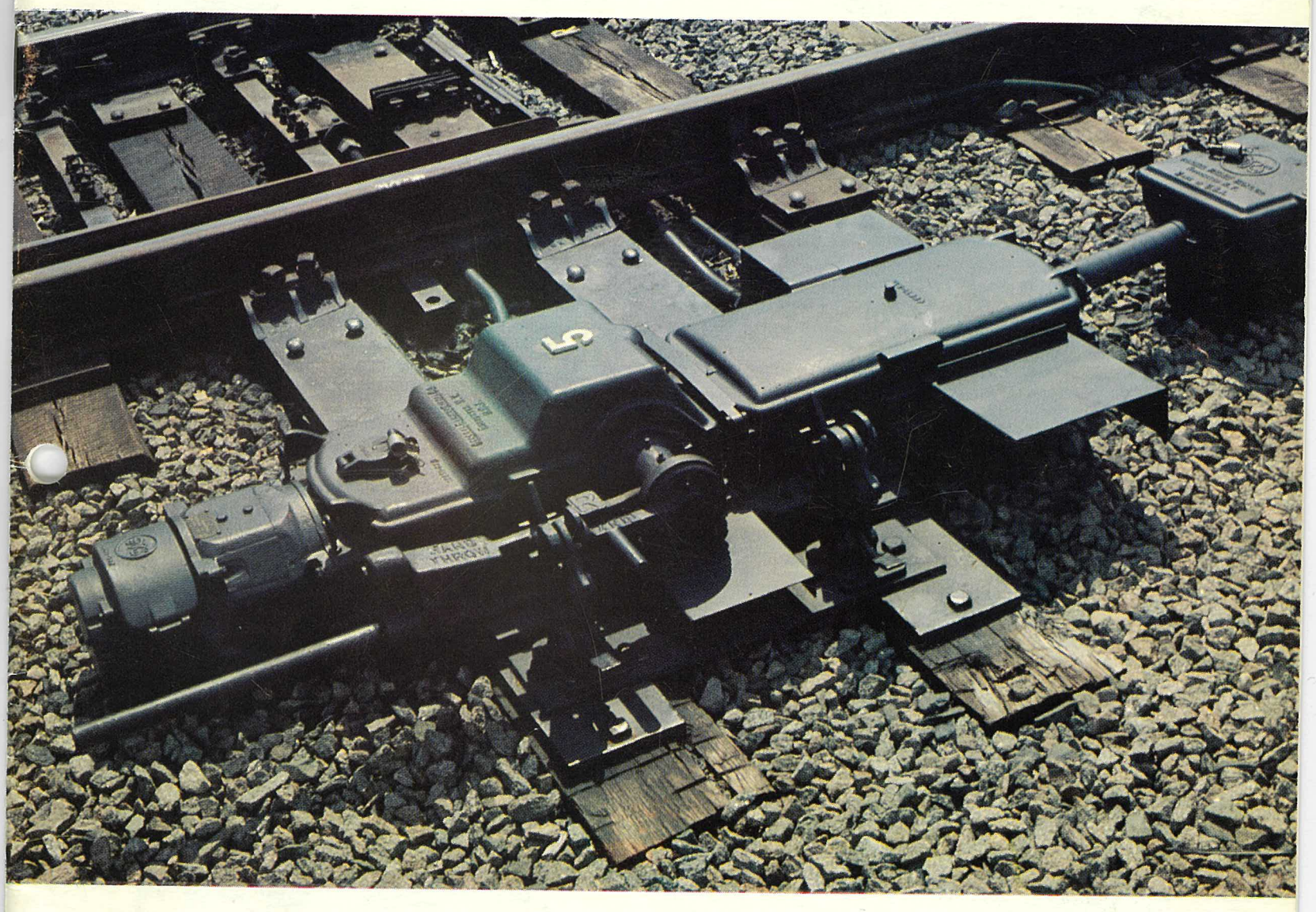
The following items are for operating the Generail transmitter from the locomotive cab.

	LOCOMOTIVE CONTROL BOX, includes two batteries * (shipped separately)	A85-1007
	**CORD COMPLETE,** with two plug connectors, for connection between locomotive control box and transmitter; approximately 12 feet long .	P85-1205

* 12.6-volt, mercury primary cells (Mallory TR289, Burgess H289, or Eveready E289).

GRS CATALOG **85-1**

MODELS 5A, 5E, 5F, 5G AND 5H ELECTRIC SWITCH MACHINES



FOR MAINLINE, INTERLOCKING, AND RAPID TRANSIT SERVICE

INTRODUCTION

GRS Models 5A, 5E, 5F, 5G and 5H electric switch machines are for use in mainline, interlocking, and rapid transit service. Model 5A switch machines are for use only in applications requiring direct operation, dynamic indication for older style interlocking machines. All models operate a single switch, single-slip switch, double-slip switch, or derail, regardless of variations in switch fitting standards and weight of rail.

All machines are compact, mount on only two ties, and fit the same standardized layout. They meet the requirements of A.A.R. Load Curve 1457, thus providing ample thrust to operate the heaviest switches.

POINT DETECTOR is an over-and-locked type circuit controller with two normal, two reverse, two shunt and two motor-control contacts. The normal and reverse contacts check and indicate when the switch points are within the proper distance of the stock rail and are locked. The motor control contacts control the motor operating circuit directly in Models 5E and 5F machines and in conjunction with the biased-neutral controller in Models 5G and 5H machines.

BIASED-NEUTRAL CONTROLLER in Models 5G and 5H machines has two biased-neutral, mechanically interlocked contactors, a blocking rectifier, and an overload relay. Each contactor has one dependent, front-back contact with a permanent magnet blowout (arc suppression). A snubbing contact provides dynamic motor braking at the end of the stroke. The magnetic structure prohibits armature operation until voltage of the proper polarity is applied across the coils.

OVERLOAD FRICTION CLUTCH in the gear train absorbs shocks encountered in switch operation. It is factory adjusted to slip when the motor operating current is from 12 to 14 amperes for 110-volt machines, and 18 to 20 amperes for 24-volt machines. The clutch in Models 5F and 5H can be removed without disassembling the dual control mechanism.

REMOVABLE HAND CRANK is available on all Model 5 machines for maintenance and emergency use. An automatic cutout contact with a latchout feature and manual reset protects the operator.

6-inch stroke

HEATERS are provided in the motor, controller, and point detector compartments.

The machines have renewable box style bearings for the throw bar, and wear plates for the lock and detector rods.

DUAL CONTROL MECHANISM in Models 5F and 5H machines permits either power or hand-throw operation.

RUGGED MOTOR provides long, reliable service. It has series split connected epoxy-coated insulated field coils and an epoxy-coated armature. Dynamic snubbing limits motor overrun at the end of the stroke, and a simple magnetic detent holding device then locks the motor armature. Magnetic holding is frictionless and virtually maintenance-free -- nothing to wear out.

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DESCRIPTION

Models 5A, 5E, 5F, 5G and 5H switch machines basically consist of an electrically operated switch and lock movement, with lock rod, point detector rod and built-in contacts that check the machine over-and-locked in both the normal and reverse positions.

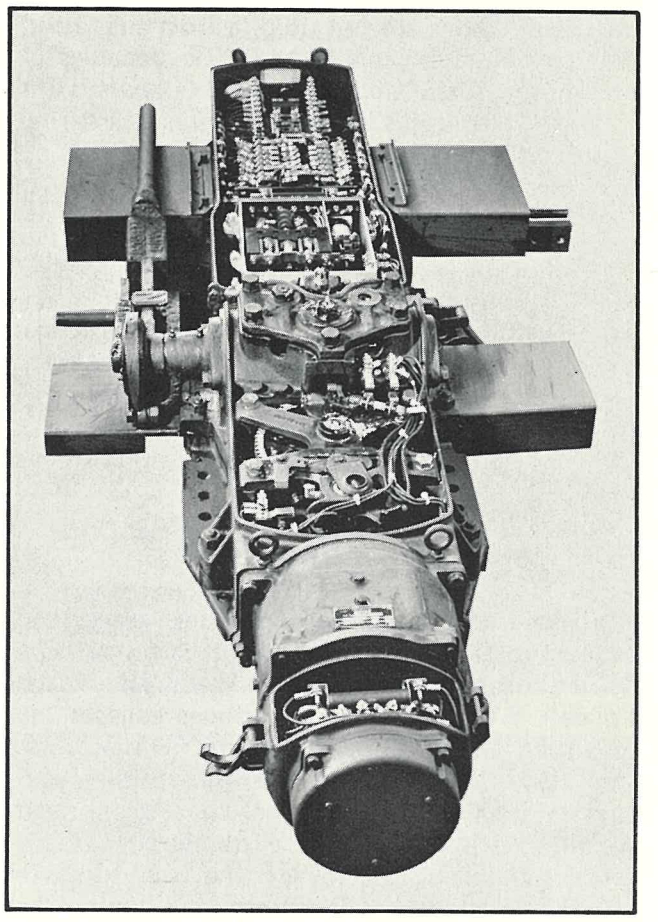
Models 5A, 5E and 5G machines are designed for power operation only; Models 5F and 5H machines have a dual control mechanism which permits either power or hand-throw operation. All models can be hand cranked for making and checking adjustments; for power-only models, hand cranking is used for emergency switch operation in case of power failure.

Control and overload relays for Models 5E and 5F are housed externally. Models 5G and 5H have a built-in biased-neutral controller operated by a low-voltage d-c, two-wire polarized line circuit. The controller, in turn, applies 24- or 110-volt d-c to the motor. This control voltage can be easily changed in the field from 24 to 10 volts to suit railroad requirements. All models (except 5A) are designed for battery indication.

Operating time is approximately 3 seconds for 110-volt machines and 8 to 10 seconds for 24-volt machines.

All models (except 5A) have a permanent magnet holding device which holds the motor after the end of the stroke. The magnetic detent then holds the motor armature against vibration and low-level stray electrical currents. Dynamic snubbing on all models serves to bring the machine to rest without shock upon the completion of the stroke. Model 5A snubs through its line wires and its interlocking machine. Internal dynamic snubbing is provided in Models 5E and 5F through contacts in the point detector, and in Models 5G and 5H through contacts in the biased-neutral controller.

The point detector has knife-edged contacts which exert extra-heavy pressure. The Model 5A has three normal, three reverse, and two shunt contacts; Models 5E, 5F, 5G and 5H have two normal, two reverse, two motor control, and two shunt contacts. The motor control contacts in Models 5E and 5F carry and break the motor current directly. Only the 5A switch machine lacks a magnetic detent as it is designed to be energized from an interlocking machine at all



MODEL REFERENCE CHART

MODEL	DUAL CONTROL	BUILT-IN CONTROLLER
5A	NO	NO
5E	NO	NO
5F	YES	NO
5G	NO	YES 10/24 vdc
5H	YES	YES 10/24 vdc

Machines provided with 110 d-c motors can be operated from 110 a-c through rectifiers external to the machine.

times. The Model 5A contains an electro-magnetically-operated pole changer.

Models 5E, 5F, 5G and 5H are frost protected by 110-volt heaters located in the motor, controller, and contact compartments. If the installed heaters are not used, a frost shield and felt commutator cover should be installed in the motor. These items are available in a modification kit which is listed later under "Ordering Information."

POWER OPERATION

To move switch points, the motor drives the intermediate gear train and the main gear. The lower end of the stud in the main gear of the Models 5A, 5E, and 5G machines engages the cam bar. On the Models 5F and 5H machines, the lower end of the crank pin in the main splined crank engages the cam bar. As the main gear rotates from either extreme position, it pushes the cam bar toward the wire entrance end of the machine. This moves the dog on the cam bar out of the notch in the lock rod, unlocking the switch points and simultaneously causing the two rollers on the point detector yoke to be centered in the lock dog. Thus, the point detector yoke is moved to the vertical position to open the normal and reverse contacts and to close the motor control contacts. Continued rotation of the main gear causes the roller bearing to move the throw bar six inches. The throw bar moves the switch points which, in turn, move the lock and detector rods.

When the switch points close in the opposite position, the point detector rod is in position so that the point detector yoke and the attached contact block are forced by spring pressure to close the opposite indication contacts. This occurs during the last stage of the cam bar movement, when the bar is withdrawn from the detector yoke rollers and simultaneously locks the lock rod in position.

MANUAL OPERATION

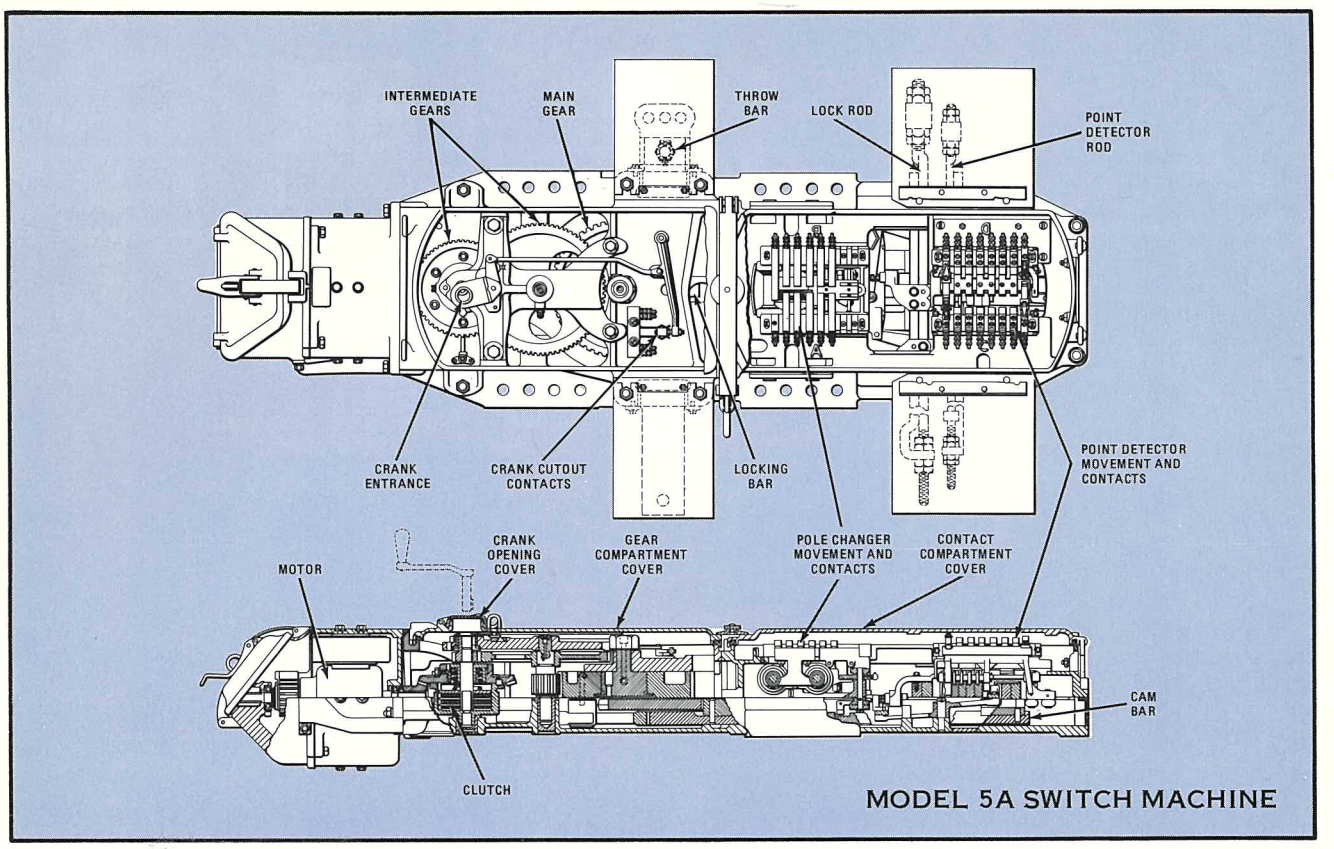
On Models 5F and 5H with dual-control, the selector lever contacts on the dual-control mechanism open the motor and repeater relay circuits when the manually-operated selector lever is moved from the POWER to the HAND position.

During hand-throw operation, cam bar movement forces the rollers on the point detector yoke to be centered in the lock dog. Thus, the point detector yoke is moved to the vertical position to open the detector contacts. The normal and reverse detector contacts do not reclose until the selector lever is returned to the POWER position and the machine, under power operation, locks into the called-for switch position.

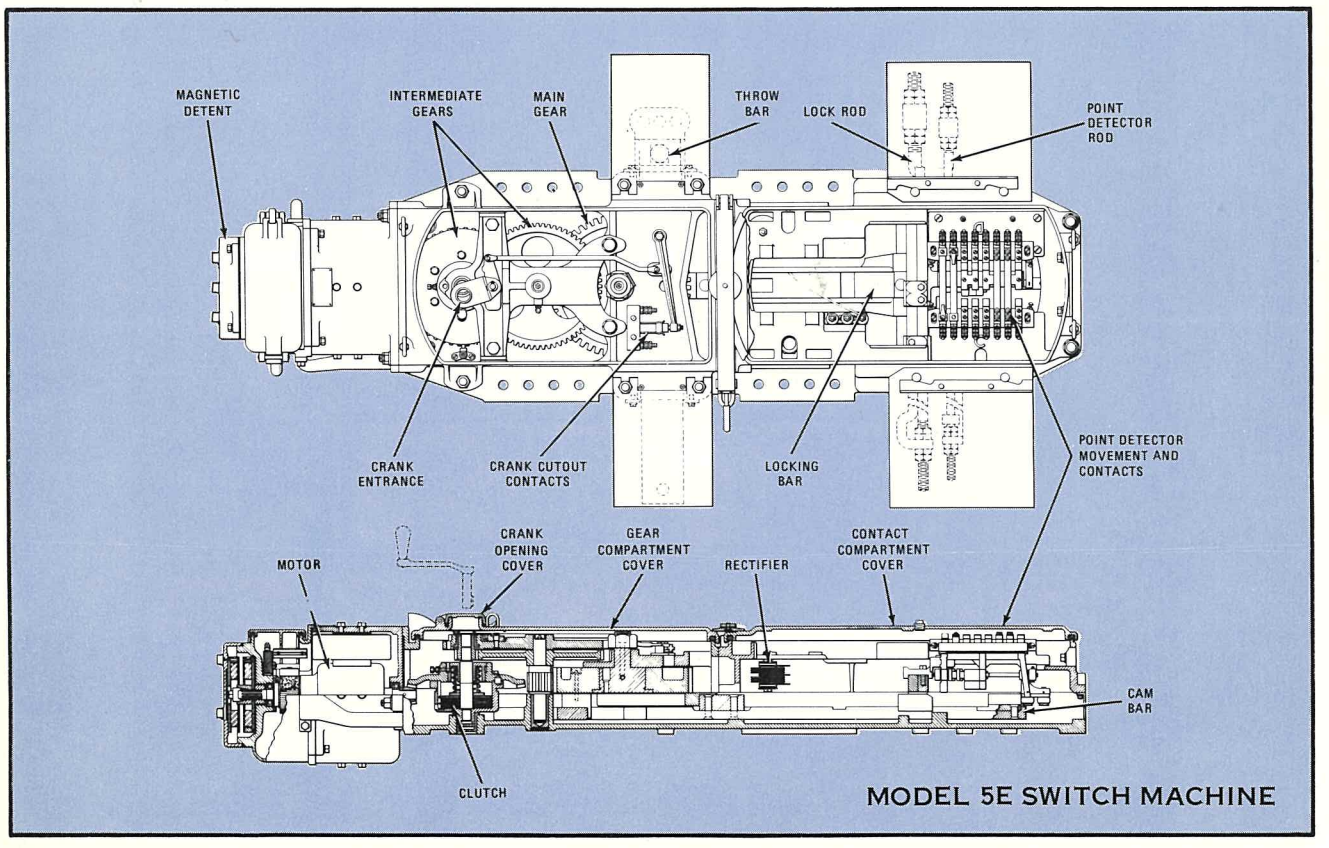
INSTALLATION

Installation and adjustment of the switch machines are relatively straightforward. Its versatility permits a number of configurations, some of which can be changed in the field.

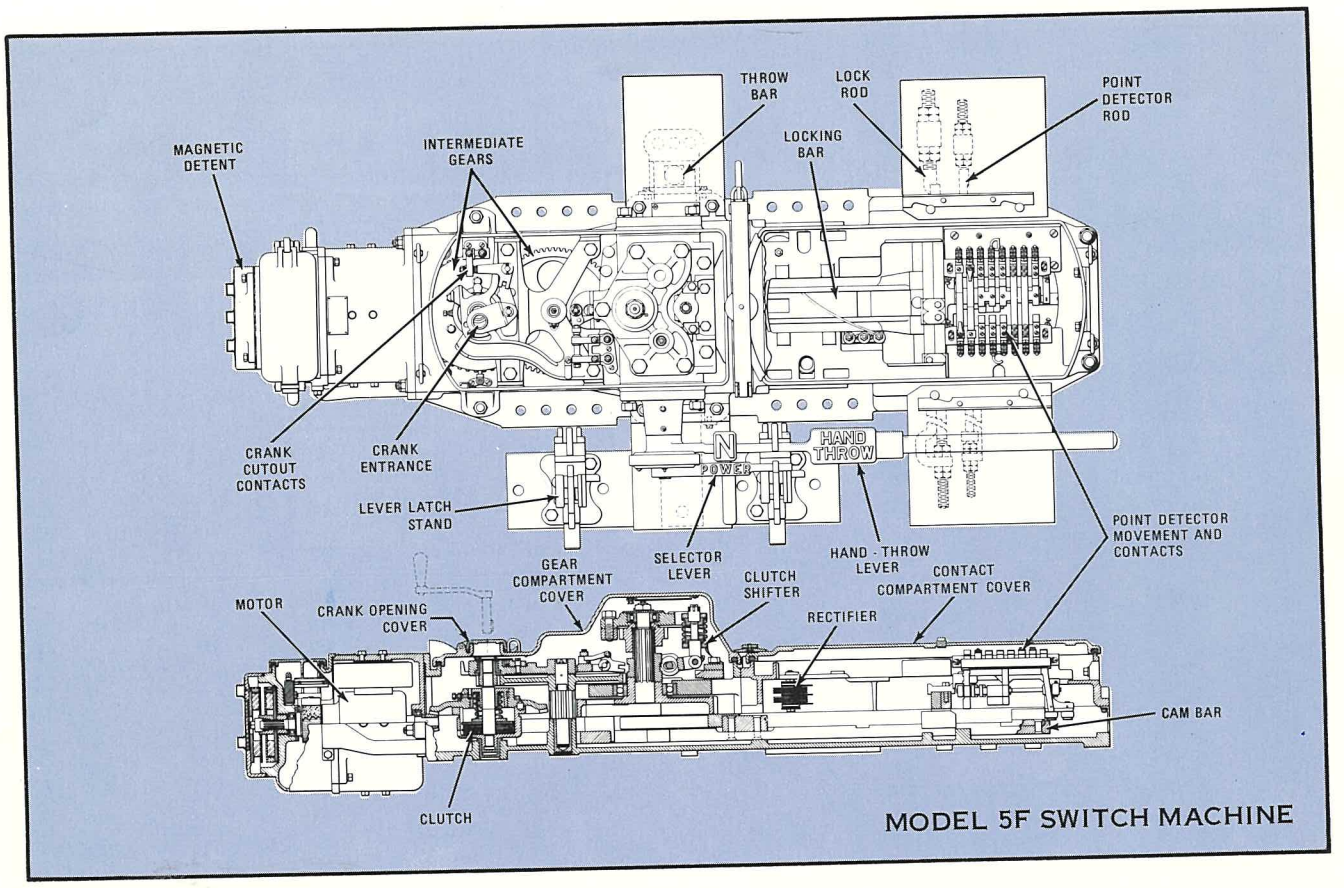
A right-hand machine is one located on the right-hand side of the track when the observer faces the switch points. Power-only machines, Models 5A, 5E, and 5G, ordered with one lock rod and one point detector rod, are shipped in the right-hand configuration only. These can be easily altered in the field to left-hand by reversing the lock rod and point detector rod in the machine and by moving the throw bar connection to the opposite end. Since changeover is more complex, the Model 5A for a movable point frog and Models 5F and 5H dual-control machines may be ordered in either right- or left-hand configurations. Complete operation, installation, and maintenance data are contained in Pamphlet 1559 for the Model 5A machine and Pamphlet 1293 for the Models 5E, 5F, 5G and 5H machines.



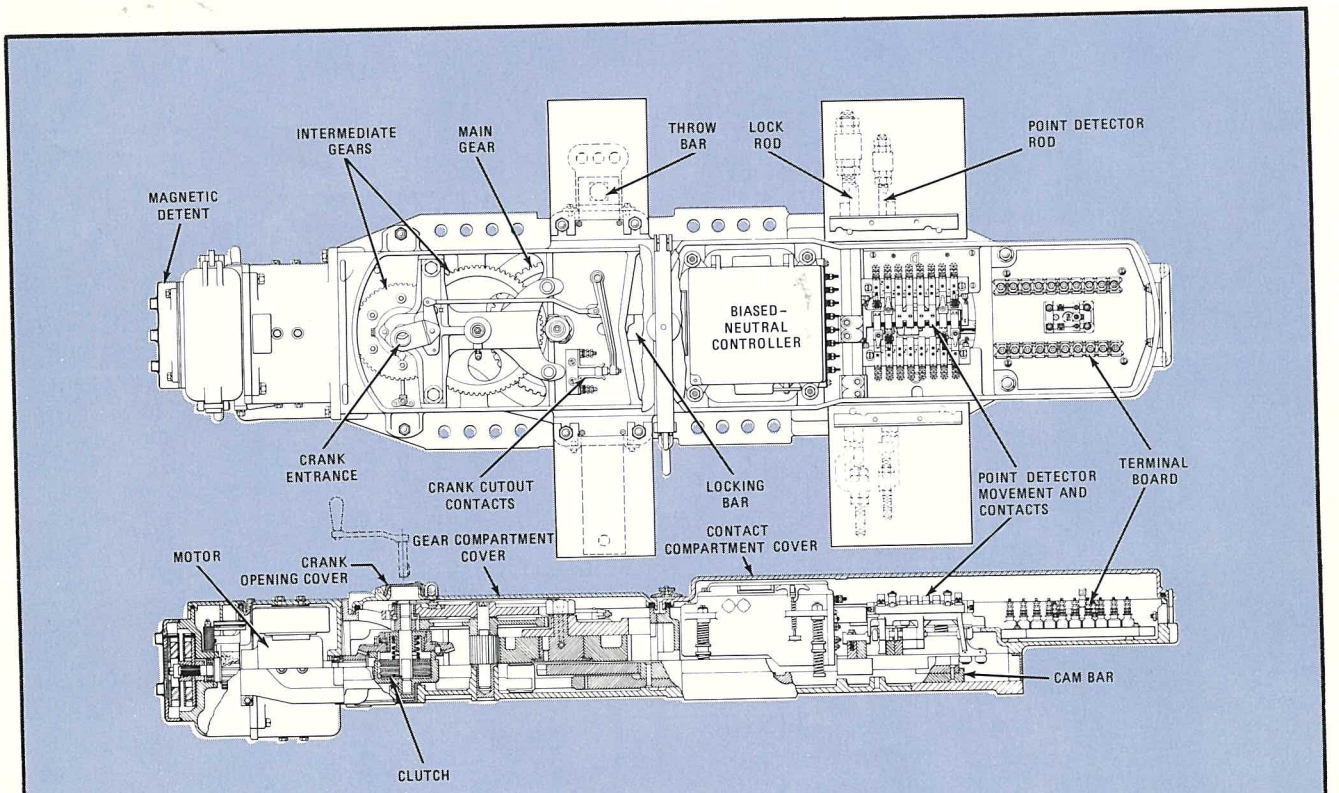
MODEL 5A SWITCH MACHINE



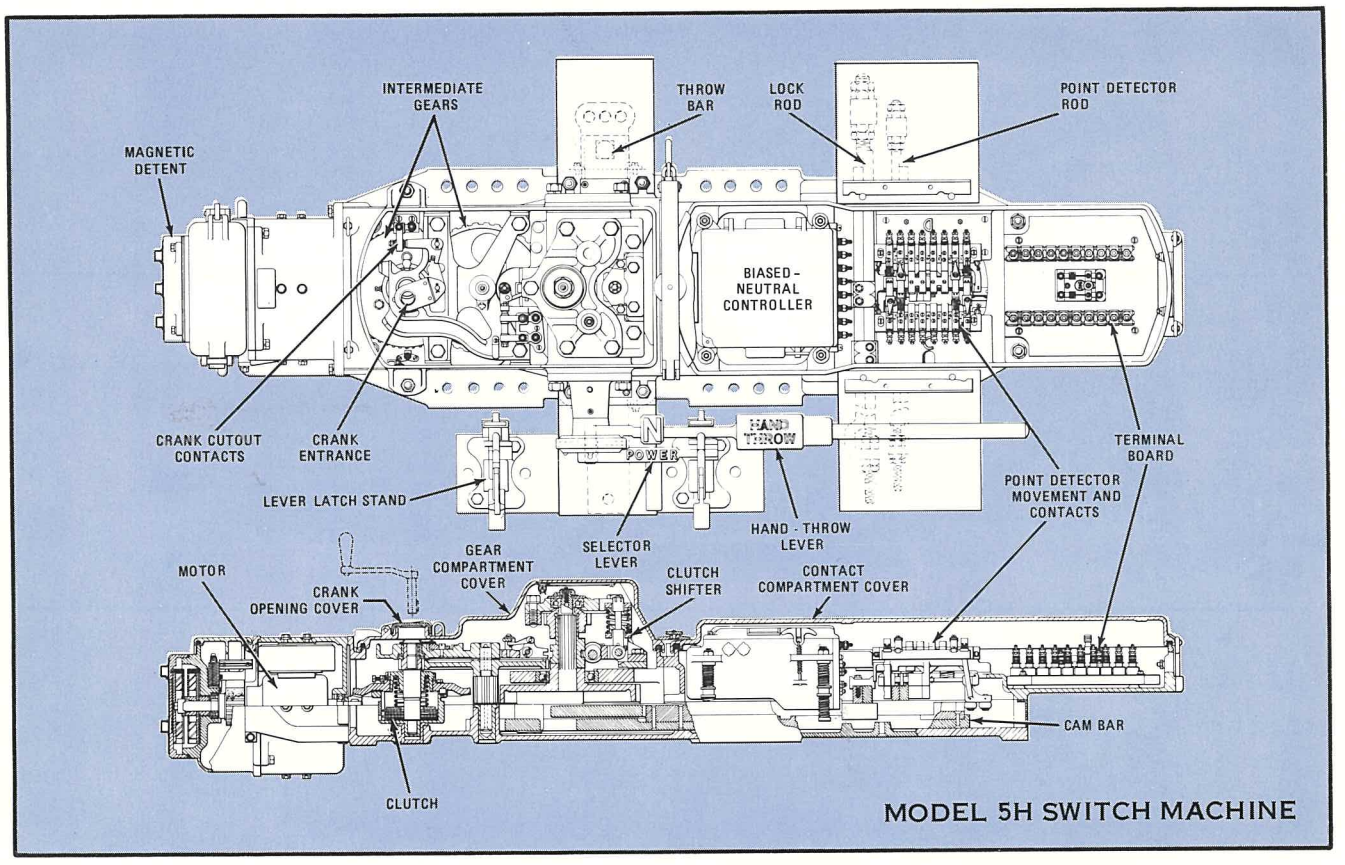
MODEL 5E SWITCH MACHINE



MODEL 5F SWITCH MACHINE

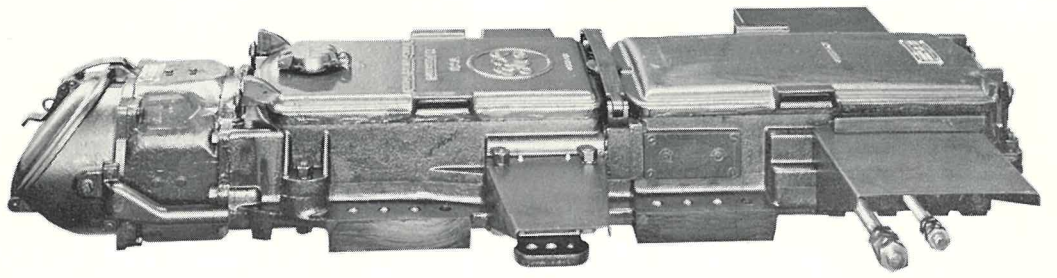


MODEL 5G SWITCH MACHINE

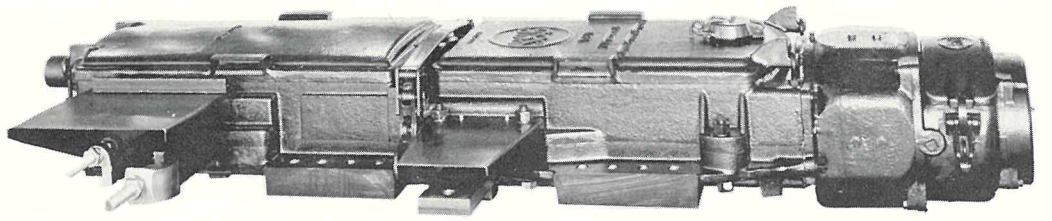


MODEL 5H SWITCH MACHINE

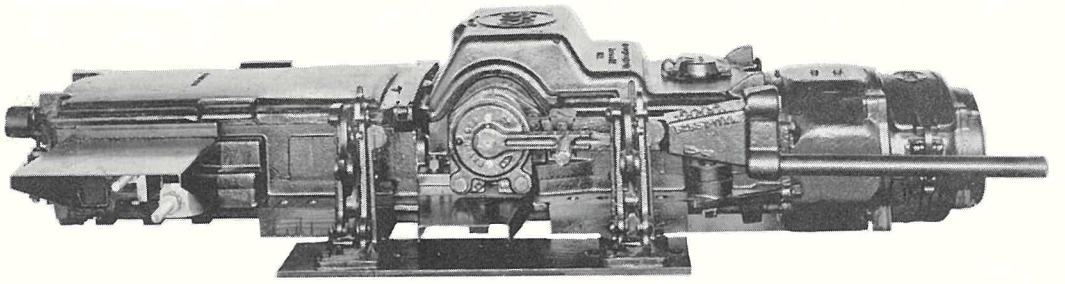
MODEL 5 SERIES SWITCH MACHINES



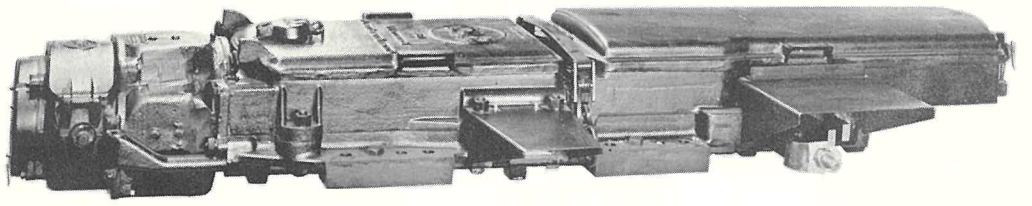
5A



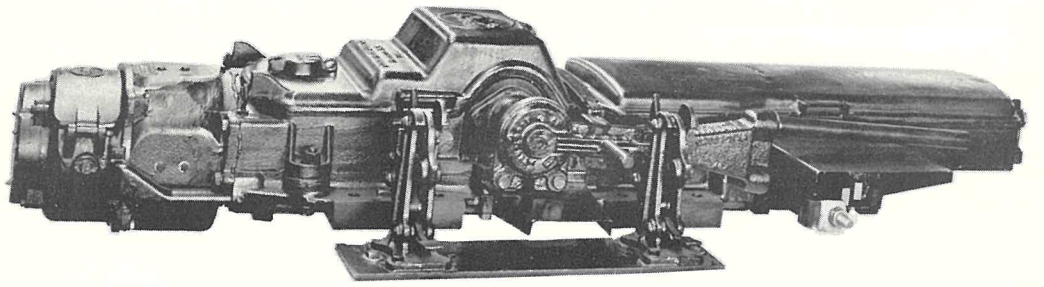
5E



5F



5G



5H

ORDERING INFORMATION

Models 5A, 5E, 5F, 5G and 5H switch machines are provided with one lock rod and one point detector rod for control of a single switch, single-slip switch, derail, or double-slip switch. Machines with two lock rods and two detector rods are available; see your GRS sales engineer for details.

NOTE: If you desire to have GRS select all parts for a complete switch layout, please complete the questionnaire on page 18.

MODEL 5A SWITCH MACHINE

The Model 5A DOES NOT INCLUDE the following; please order separately:

- Accessories; see pages 15, 16, and 17.
- Lock and point detector rods, throw rods, and junction boxes; see Assemblies Catalog Section 91.

To order, specify "Model 5A Switch Machine" and give catalog number.

For single switch; single-slip switch; derail; or double-slip switch with machine having 1 lock and 1 point detector rod:

Operating Voltage D-c	Right or Left Hand	Catalog Number
110	Right*	A85-100

Same as above, except have throw-bar detection switch:

110	Right	A85-145
110	Left	A85-146

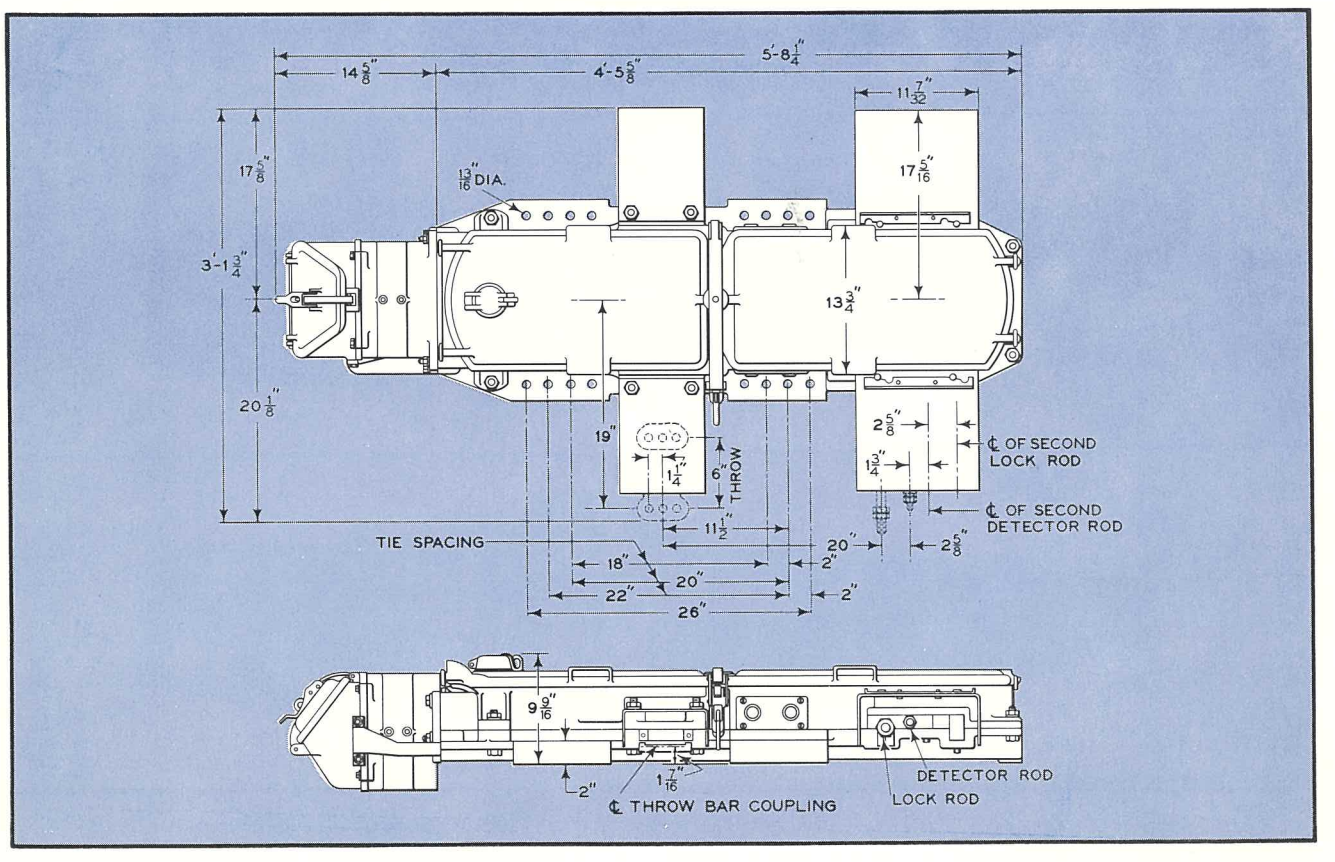
For movable point frog:

Operating Voltage D-c	Right or Left Hand	Catalog Number
110	Right	A85-130
110	Left	A85-140

Same as above, except have throw-bar detection switch:

110	Right	A85-147
110	Left	A85-148

*Can be changed to left-hand layout in field; see page 4.



MODEL 5E SWITCH MACHINE

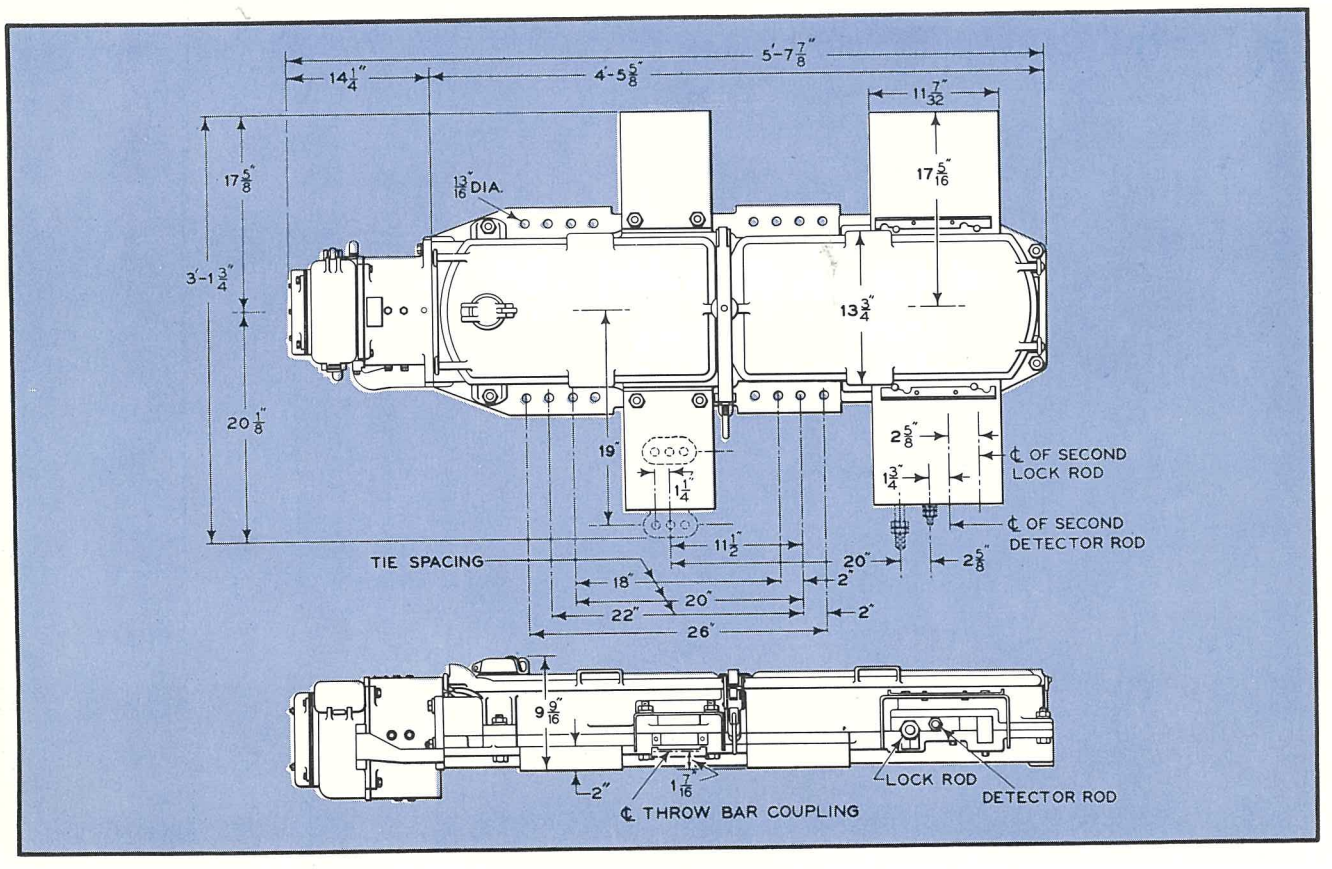
The Model 5E DOES NOT INCLUDE the following; please order separately:

- Accessories; see pages 15, 16, and 17.
- Type B or Type K switch control and switch overload relays; see Assemblies Catalog Sections 62 and 65.
- Lock and point detector connecting rods, throw rods, and junction boxes; see Assemblies Catalog Section 91.

To order, specify "Model 5E Switch Machine" and give catalog number.

Operating Voltage D-c	Right or Left Hand	Catalog Number
110	Right Only*	A85-151
24	Right Only*	A85-153

*Can be changed to left-hand layout in field; see page 4.



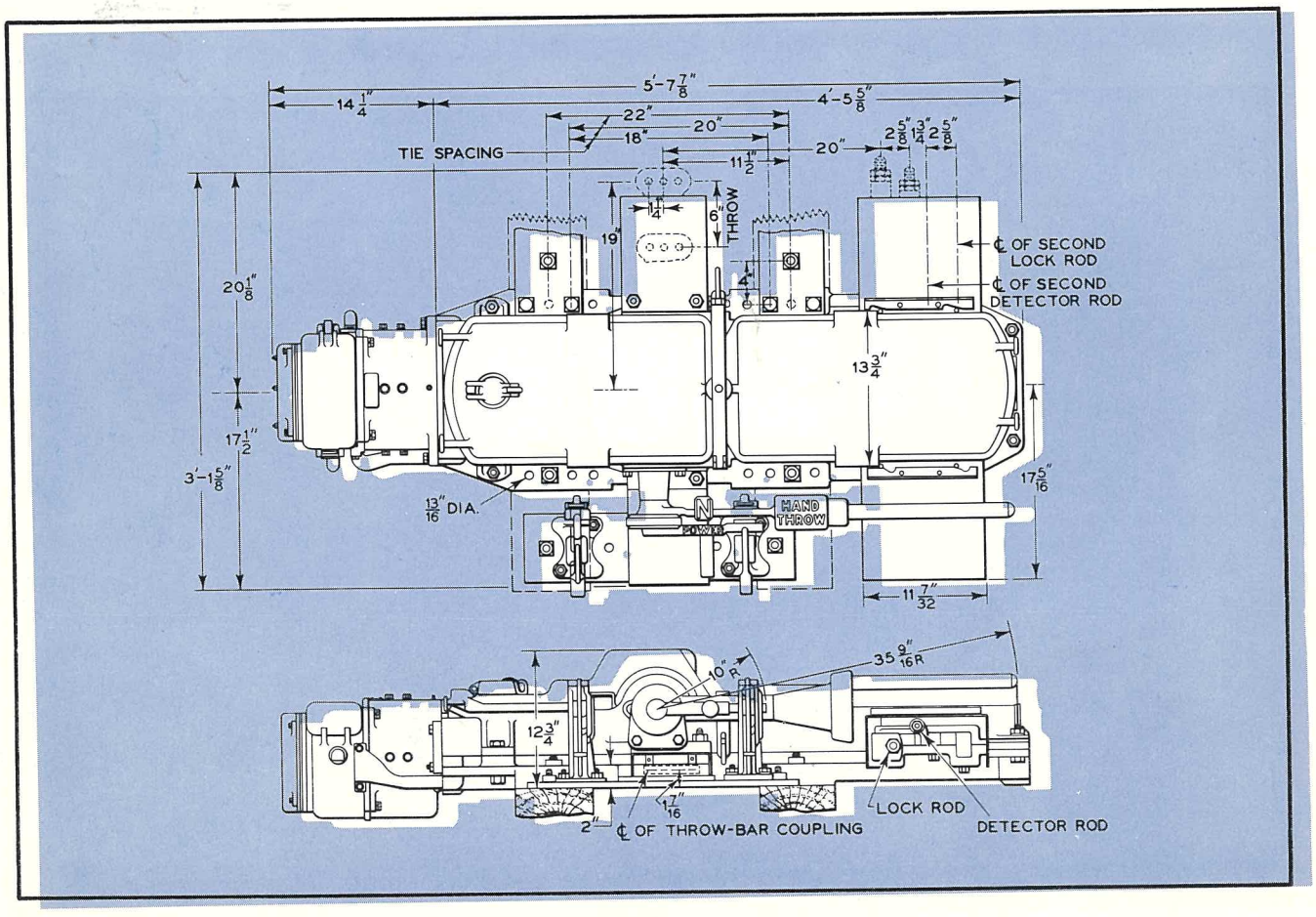
MODEL 5F DUAL CONTROL SWITCH MACHINE

The Model 5F DOES NOT INCLUDE the following; please order separately:

- Accessories; see pages 15, 16, and 17.
- Type B or Type K switch control and switch overload relays; see Assemblies Catalog Sections 62 and 65.
- Lock and point detector connecting rods, throw rods, and junction boxes; see Assemblies Catalog Section 91.

To order, specify "Model 5F Switch Machine" and give catalog number.

Operating Voltage D-c	Right or Left Hand	Catalog Number
110	Right	A85-201
110	Left	A85-203
24	Right	A85-206
24	Left	A85-208



MODEL 5G SWITCH MACHINE

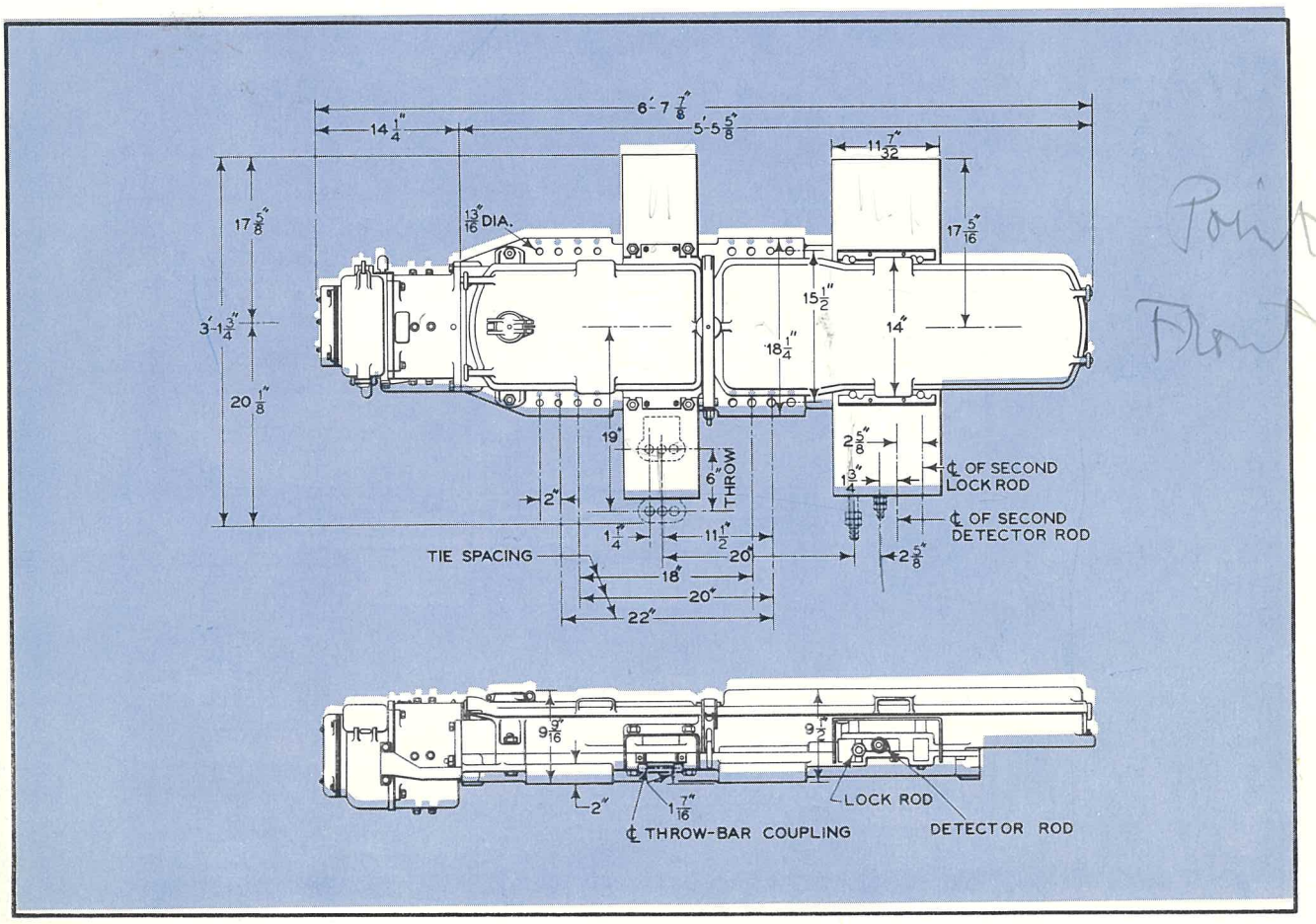
The Model 5G DOES NOT INCLUDE the following; please order separately:

- Accessories; see pages 15, 16, and 17.
- Lock and point detector connecting rods, throw rods, and junction boxes; see Assemblies Catalog Section 91.

To order, specify "Model 5G Switch Machine" and give catalog number.

Operating Voltage D-c	Control Voltage D-c	Right or Left Hand	Catalog Number
110	10 or 24	Right Only*	A85-247
24	10 or 24	Right Only*	A85-251

*Can be changed to left-hand layout in field; see page 4.



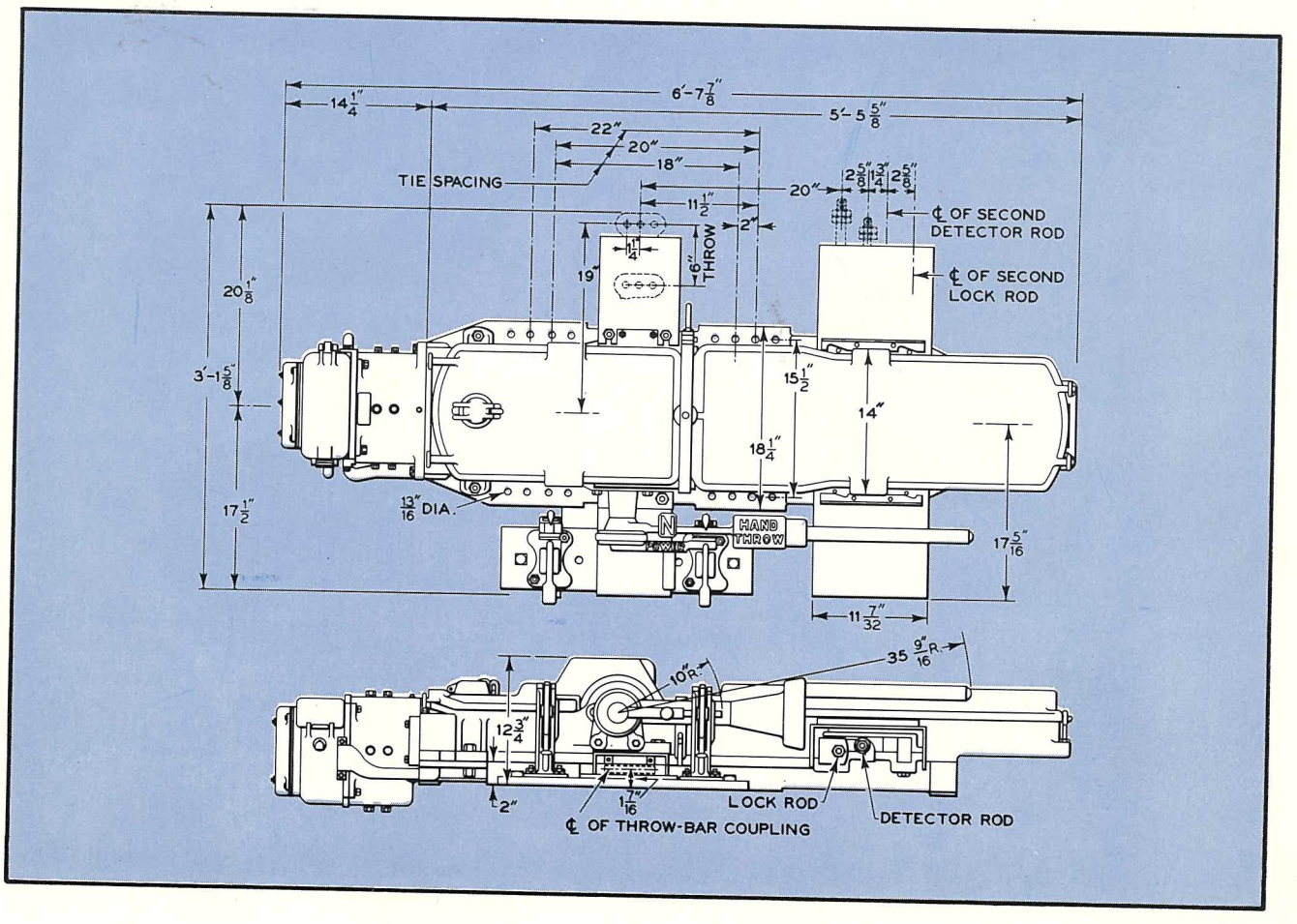
MODEL 5H DUAL CONTROL SWITCH MACHINE

The Model 5H DOES NOT INCLUDE the following; please order separately:

- Accessories; see pages 15, 16, and 17.
- Lock and point detector connecting rods, throw rods, and junction boxes; see Assemblies Catalog Section 91.

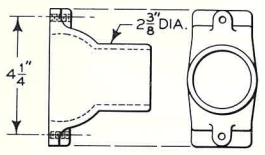
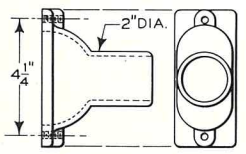
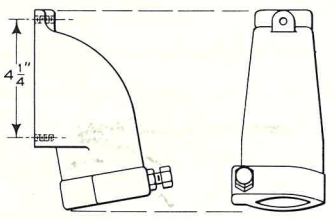
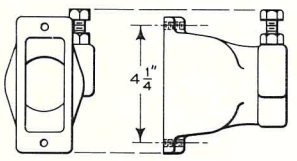
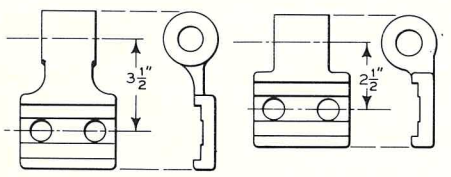
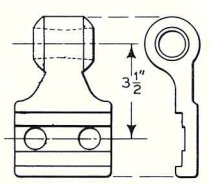
To order, specify "Model 5H Switch Machine" and give catalog number.

Operating Voltage D-c	Control Voltage D-c	Right or Left Hand	Catalog Number
110	10 or 24	Right	A85-302
110		Left	A85-304
24	10 or 24	Right	A85-312
24		Left	A85-314



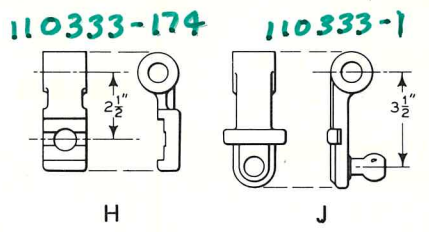
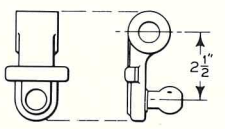
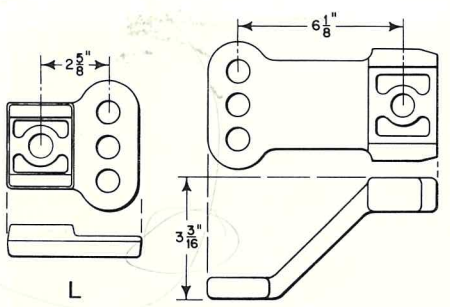
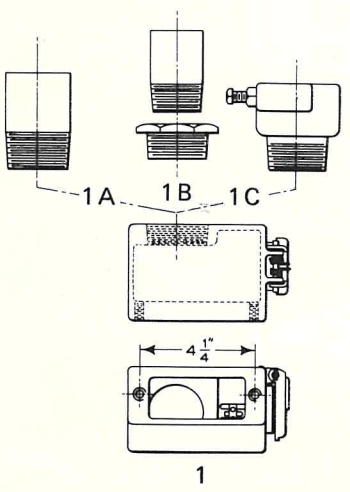
ACCESSORIES

PLEASE ORDER BY CATALOG NUMBER AND NAME SHOWN IN BOLD TYPE

REFERENCE	NAME	CATALOG NUMBER
 A	**A. COUPLING,** wire entrance, for 2-3/8" I. D. split or solid rubber conduit	**A85-500**
 B	**B. COUPLING,** wire entrance, for 1-7/8" I.D. split or solid rubber conduit	**A85-501**
 C	**C. COUPLING,** wire entrance, offset, for 2" flexible conduit	**A85-502**
 D	**D. COUPLING,** wire entrance, straight, for 2" flexible conduit	**A85-503**
 E F	**E. LUG,** lock rod, 3-1/2" spacing, for 1" diameter lock rod	**A85-560**
	F. LUG, lock rod, 2-1/2" spacing, for 1" diameter lock rod	**A85-561**
 G	**G. LUG,** lock rod, 3-1/2" spacing, swivel type, for 1" diameter lock rod, includes cap nuts	**A85-562**

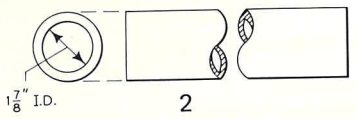
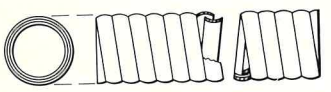
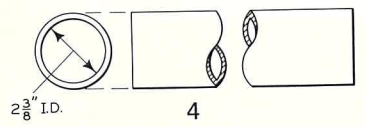
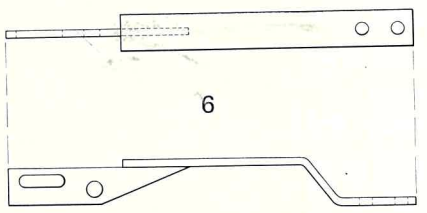
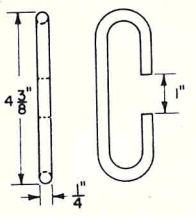
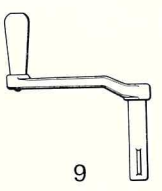
ACCESSORIES (cont'd)

PLEASE ORDER BY CATALOG NUMBER AND NAME SHOWN IN BOLD TYPE

REFERENCE	NAME	CATALOG NUMBER
	**H. LUG,** detector rod, 2-1/2" spacing, for 3/4" diameter rod, noninsulated	**A85-563**
	J. LUG, detector rod, 3-1/2" spacing, for 3/4" diameter detector rod, noninsulated, needs grease fitting, reference 5 . .	**A85-564**
	**K. LUG,** detector rod, 2-1/2" spacing, for 3/4" diameter detector rod, noninsulated, needs grease fitting, reference 5 . .	**A85-565**
	K1. LUG, same as K above except insulated	**A85-566**
	K2. LUG, same as K above except insulated and for 1" diameter detector rod	**A85-567**
	**L. COUPLING,** throw bar	**P85-709**
	M. COUPLING, offset for throw bar	**P85-925**
	**1. WIRE ENTRANCE COUPLING,** with telephone jack, mounted in case, no conduit fittings	**A85-510**
	1A. As above, except with fitting for 2-3/8" I. D. rubber conduit	**A85-511**
	1B. Same as Ref. 1, except with fitting for 1-7/8" I.D. rubber conduit	**A85-512**
	1C. Same as Ref. 1, except with fitting for 2" flexible conduit	**A85-513**

ACCESSORIES (cont'd)

PLEASE ORDER BY CATALOG NUMBER AND NAME SHOWN IN BOLD TYPE

REFERENCE	NAME	CATALOG NUMBER
 2	2. **CONDUIT,** 1-7/8" I. D., solid rubber, recommended length 3' -- specify number of feet required	A85-520
 3	3. **CONDUIT,** 2" flexible, recommended length 3' --specify number of feet required	A85-530
 4	4. **CONDUIT,** 2-3/8" I. D., solid rubber, recommended length 3' -- specify number of feet required	A85-535
5	5. **GREASE FITTING,** for detector rod lugs.	P87-101
 6	6. **TEST BAR,** provides means to check operation of machine and circuits before connecting machine to switch	P85-1357
 7	7. **GAUGE,** for adjustment of point detector rod without releasing lock rod.	P85-1216
	8. **MODIFICATION KIT,** frost shield and felt commutator cover for the motor, required when heaters will not be used in switch machines	P85-1356
 9	9. **HAND CRANK,** for set-up and emergency operation of switch machine	P85-826

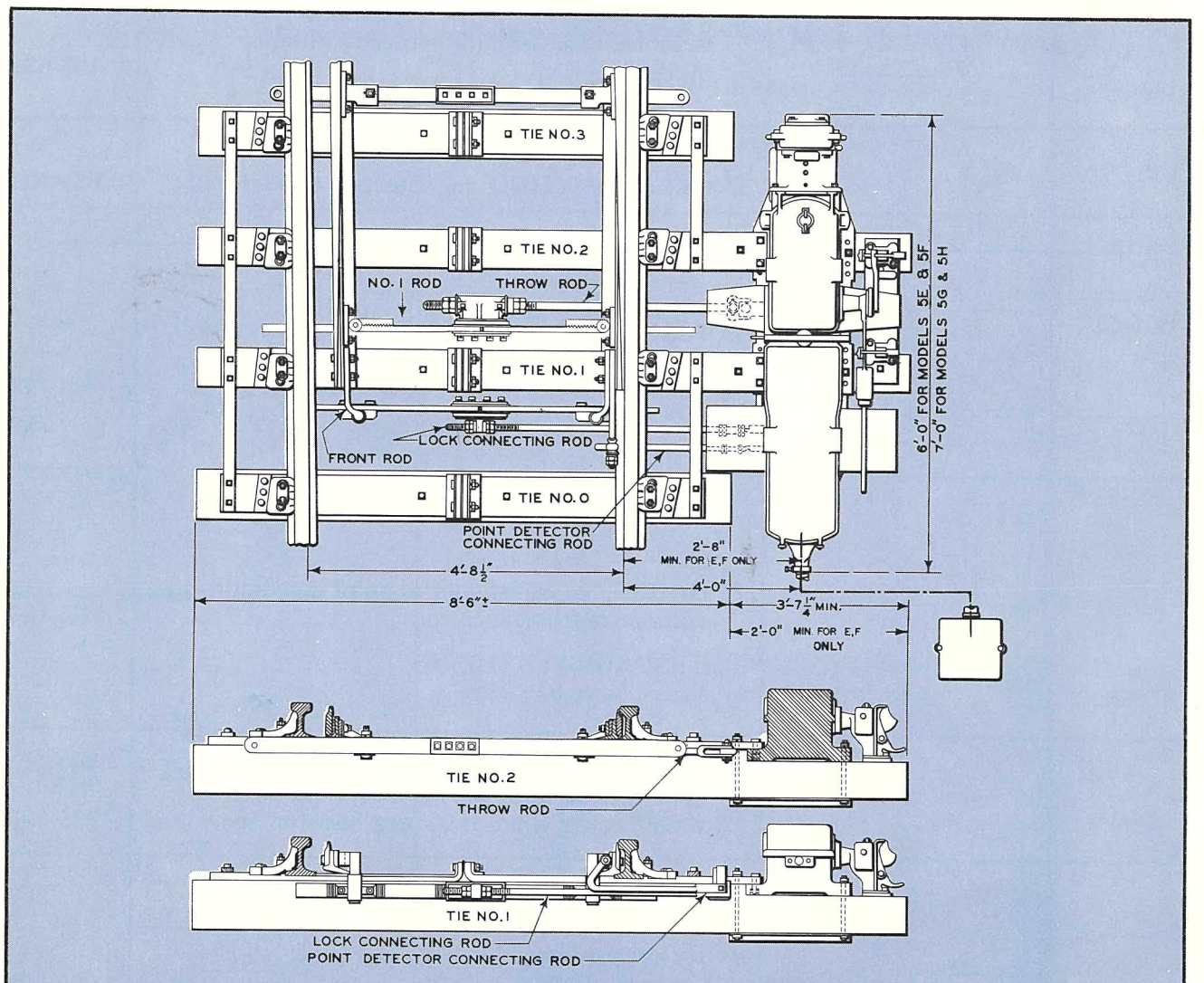
QUESTIONNAIRE

Complete Switch Layout

If you wish, GRS can select all parts for you to make up a complete layout as shown here (but not including: rails, rail fastenings, ties, tie straps, number one rod, or gauge plates). Bolts furnished will be for full length, one inch thick gauge plates, as shown. Also, the necessary connecting plate, bolts, insulation, etc. will be included to insulate your number one rod. Front rod and junction terminal box will not be included unless you specify same. Please give us the following information:

1. Catalog number of Model 5 switch machine you want. Refer to pages 10 through 14. You need not specify conduit, lugs, etc., unless you have a particular preference, as we will select them for you.
2. Characteristics of your number one rod:
   Horizontal: _____ Vertical: _____ Inches thick: _____
3. Distance from centerline of switch machine to gauge of rail: _____
4. Weight of rail: _____
5. Do you wish to include:
   Junction Terminal Box A91-230?
   Yes: _____ No: _____

Front Rod? If so, please select from Catalog Section 91 and state catalog number: _____



Typical right-hand single-switch layout with GRS hinged front rod.

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GENERAL RAILWAY SIGNAL

A UNIT OF GENERAL SIGNAL

PAMPHLET 1293
REV. AUGUST 1974

GRS
MODELS 5E, F, G, and H
ELECTRIC
SWITCH MACHINES

INSTALLATION and MAINTENANCE

PLEASE NOTE : FOR BLOCK TYPE DERAILS

TRANSPOSE LEADS TO MOTOR TERMINALS 3 AND 4

(See Figures 8, 16, 22, 23, 24, 25, 34, and 35.)

Please affix this sticker to cover of Pamphlet 1293 "GRS Models 5E, F, G, and H Electric Switch Machines"

9-74 General Railway Signal Co., Rochester, N.Y. A1703

SUPERSEDES PAMPHLETS 1270 AND 1271

GENERAL RAILWAY SIGNAL COMPANY
A UNIT OF GENERAL SIGNAL
ROCHESTER NEW YORK 14602

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CONTENTS

	Page
INTRODUCTION	4
GENERAL DESCRIPTION	
Model 5E Switch Machine	4
Model 5F Switch Machine	4
Model 5G Switch Machine	4
Model 5H Switch Machine	5
INSTALLATION AND ADJUSTMENT	
General	5
Left- or Right-Hand Layout	5
Mounting	5
Wiring	5
Throw Rod — To Connect and Adjust	5
Point-Detector Rod — To Connect and Adjust	6
Lock Rod — To Connect and Adjust	6
Machine with Two Lock Rods and Two Point-Detector Rods	6
Before Placing Machine in Service	6
LUBRICATION	
General	8
CERAMIC PERMANENT MAGNET HOLDING DEVICE	
Operation	11
Inspection	12
MOTOR	
Motor Field Connections	12
Dynamic Snubbing	12
Commutator Shield	12
Commutator Cover	12
Commutator and Brushes	13
GEARING	
Models 5E and 5G — To Remove Gears	13
Models 5E and 5G — To Reassemble Gears	13
Models 5F and 5H — To Remove Gears	13
Models 5F and 5H — To Reassemble Gears	14

FRICTION CLUTCH
To Test Clutch 15
To Adjust Clutch 15
Models 5F and 5H — To Remove Clutch 15

POINT DETECTOR
General 16
Model 5E and F Normal and Reverse Contacts C5, C8, D1, and D4, and Snub Contacts C3, C4, D5 and D6 (Figure 11) Model 5G and H C3, C6, D3, and D6 16
Model 5E and F Shunt Contacts C6, C7, D2, and D3 (Figures 12 and 13) 16
Model 5G and H Shunt Contacts C7, C8, D1 and D2 (Figure 13) 17
Motor-Control Contacys (Figures 14 and 15) 17

BIASED-NEUTRAL CONTROLLER
Operation of Biased-Neutral Controller 18
Construction of Contactors 19
Test and Operating Values 19
Centering Device 19
Blocking Rectifier 19
Snub Rectifier 19
Operation of Overload Relay 20
To Remove Controller 20
To Replace Controller 20
Maintenance and Adjustment 20

TO CHANGE FROM LEFT- TO RIGHT-HAND OPERATION OR VICE VERSA
Throw Bar 21
Lock and Detector Rods (Catalog Sec. P85) 21
Dual-Control Mechanism (Models 5F and 5H) 23

TIMING TEST PROCEDURES
Displacement of Upper Crank Bearing Washer 24
Displacement of Cam Bar C, Figure 5 24
Hand-Throw Clutch Engagement 24

INTRODUCTION

The GRS Models E, F, G and H switch machines incorporate all features required to meet interlocking practices. They can be used at single switches, double-slip switches, movable-point frogs, and derails, regardless of variations in switch fitting standards and weights of rail.

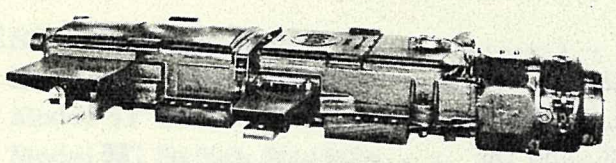

Figure 1a. Model 5E switch machine.

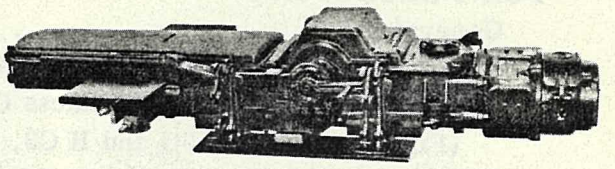

Figure 1b. Model 5F switch machine.

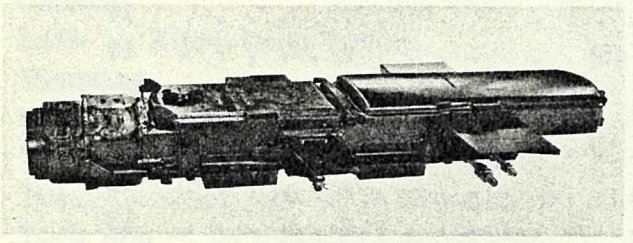

Figure 1c. Model 5G switch machine.

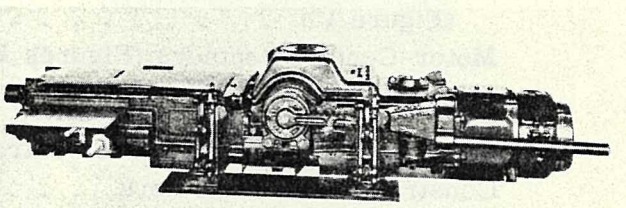

Figure 1d. Model 5H switch machine.

GENERAL DESCRIPTION

The low-voltage switch machines have a 24- to 32-volt d-c motor and operates in approximately 10 seconds. The high-voltage machines operate on 110-volt d-c in approximately 3 seconds.

A dynamic snub arrangement stops the motor after the machine has operated and locked the switch. A ceramic permanent magnet holding device holds the motor armature after the snub stops armature rotation. The holding device is also effective whenever energy is removed from the motor.

A silicone-treated, moisture-repellent cover surrounds the motor commutator. A transparent shield is located above the commutator.

The point-detector contacts are knife edged and close with extra heavy pressure and long wipe. The heavy-duty motor control contacts carry and break motor current directly.

The machines are equipped with renewable box style bearings for the throw bar and wear plates for the lock and detector rods.

Model 5E Switch Machine

The Model 5E switch machine is designed for power operation only. A hand crank is provided for making and checking adjustments and for emergency use.

Control and overload relays are housed externally. The two-wire control circuit uses two biased-neutral control relays and a neutral overload relay. Three wires for motor control are required between the relay housing and the switch machine. The number of indication wires required depends on the type of circuit used. See Circuits, Figures 22-25.

Model 5F Switch Machine

The Model 5F switch machine is the same as the Model 5E machine except that it is equipped with a dual-control mechanism. The Model 5F machine, therefore, is designed for both power and hand-throw operation. A hand crank is provided for making and checking adjustments.

The design of the gear train in the Model 5F machine permits removal and replacement of the clutch without disassembling the dual-control mechanism.

Model 5G Switch Machine

The Model 5G switch machine is designed for power operation only. The hand crank is provided for making and checking adjustments and for emergency use.

The Model 5G switch machine is equipped with a

biased-neutral controll
to 12- or 24- to 32-vol
controller either throu
or directly through the
troller also provides o
snubbing of the switch

The point-detector
close with extra heavy

The Model 5G switc
newable box style bear
plates for the lock and

General

Satisfactory operation
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railroad, and adjust ac
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placed in service, and
quent periodic lubricat
switch layout in good c
tect against possible w
machine.

Left- or Right-Hand L

The Models 5E and
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right-hand operation o
left hand in the field by
ling and the lock and th
chine. Instructions ar

The Models 5E and
point-detector rods, an
machines can be order
left-hand operation. (
These machines can b
hand, or vice versa, i
given on page 21.

Mounting

The ties which supp
switch must be well ta
withstand vibration.
port the machine also
when required, proper

Mount the machine
so that there will be n
respect to the rails.
and layout plans for th

biased-neutral controller. The control energy (10- to 12- or 24- to 32-volts d-c) can be applied to the controller either through relays located near the switch, or directly through the switch control lever. The controller also provides overload protection and dynamic snubbing of the switch machine motor.

The point-detector contacts are knife edged and close with extra heavy pressure and long wipe.

The Model 5G switch machine is equipped with renewable box style bearings for the throw-bar and wear plates for the lock and detector rods.

Model 5H Switch Machine

The Model 5H switch machine is the same as the Model 5G machine except that it is equipped with a dual-control mechanism. The Model 5H machine, therefore, is designed for both power and hand-throw operation. A hand crank is provided for making and checking adjustments.

The design of the gear train in the Model 5H machine permits removal and replacement of the clutch without disassembling the dual control mechanism.

INSTALLATION AND ADJUSTMENT

General

Satisfactory operation of the switch machine depends upon correct installation, adjustment, lubrication, and maintenance, and the condition of the switch layout. Install the switch machine in accordance with the detail mounting arrangements approved by the railroad, and adjust according to the following instructions. Lubricate the machine thoroughly when it is placed in service, and establish a program for subsequent periodic lubrication and maintenance. Keep the switch layout in good condition and well drained to protect against possible water accumulation around the machine.

Left- or Right-Hand Layout

The Models 5E and 5G switch machines with one lock rod and one point-detector rod are supplied for right-hand operation only. They can be changed to left hand in the field by reversing the throw bar coupling and the lock and the point-detector rod in the machine. Instructions are given on page

The Models 5E and 5G with two lock rods and two point-detector rods, and all Models 5F and 5H switch machines can be ordered for either right-hand or left-hand operation. (See Assemblies Catalog Sec. 85.) These machines can be changed from right-hand to left-hand, or vice versa, in the field. Instructions are given on page 21.

Mounting

The ties which support the switch machine and the switch must be well tamped for their entire length to withstand vibration. The two extended ties which support the machine also must be reasonably straight and, when required, properly framed.

Mount the machine and fasten it securely to the ties so that there will be no movement of the machine with respect to the rails. Follow the railroad's mounting and layout plans for the particular location.

Wiring

1. Models 5E and 5F:

   Operating circuits are completely wired at the factory. Wire the point detector and connect the external wires to the terminal posts in the machine in accordance with the detail wiring plan that applies to the location.

2. Models 5G and 5H:

   The biased-neutral controller, motor, and point detector are completely wired at the factory. In the field, the external wires for switch control, motor energy, and repeater relay circuits are brought into the machine through a suitable wire entrance fitting and connected to the terminal board posts. To connect these external wires, follow the railroad's detail wiring plan for the location.

Typical switch machine wiring diagrams and repeater relay circuits are included at the back of this book. The repeater relay circuits show metal connectors between some adjacent posts on the terminal board. The connectors are supplied with each new machine and must be arranged as required in the field.

Hand-Throw Lever (Models 5F and 5H only)

Check that the locations of the letters N and R on the hand-throw lever correspond to the positions of the switch when the machine is operated by hand.

Throw Rod — To Connect and Adjust

1. Connect the throw rod to the coupling on the throw bar.
2. Crank the machine to the end of the throw-bar stroke. The stroke is six inches.
3. Adjust the nuts at the switch basket to obtain proper pressure at the switch points. Lock the nuts in this position. Nothing is gained from excessive pressure.

4. Crank the machine to the opposite position. Repeat operation 3.

5. After the adjustments in both directions have been made, crank the machine back and forth a few times to check these adjustments.

Point-Detector Rod — To Connect and Adjust

1. Fasten the point-detector connecting rod to the switch and to the lug on the point-detector rod.

2. Crank the machine to close and lock the far switch point.

3. Adjust the rod by means of the nuts on the track end until the locating notch on the top of the rod, on the field end, is even with the finished surface on the outside of the contact frame. Tighten and lock the nuts.

4. Crank the machine to close and lock the near switch point.

5. Move the adjusting plate of the point-detector rod until the locating notch on the top of this plate, on the track end, is even with the finished surface on the outside of the contact frame. Tighten and lock the nuts that hold this adjustment.

6. After the adjustments in both directions have been made, crank the machine back and forth a few times to check that the locating notches return to the proper position at the end of each throw-bar stroke.

NOTE: The locating notches on the point-detector rod indicate only that the rollers of the point-detector yoke are in the center of the semicircular notches in the point detector rod. Final adjustments must be made in accordance with AAR or railroad instructions.

Lock Rod — To Connect and Adjust

1. Remove the guards over the lock and detector rods.

2. Position the lug on the lock rod in the center of the threaded section. Run the nuts finger-tight against each side.

3. Assemble the lock-rod connecting rod to the lug on the front rod and to the lug on the lock rod.

4. Crank the machine to close, but not lock, the far switch point. Move the lock rod toward the track until the locating notch on the top of the rod, on the field end, is even with the finished surface on the outside of the contact frame.

5. Crank the machine to close and lock the far switch point. Tighten and lock the nuts on the lock-rod connecting rod against each side of the lug on the front rod.

6. For a closer adjustment, adjust the nuts on each side of the lug on the lock rod.

7. Crank the machine to close, but not lock, the near switch point. Move the adjusting plate of the lock rod until the locating notch on the top of this plate, on the track end, is even with the finished surface on the outside of the contact frame. Tighten and lock the nuts that hold this adjustment.

8. After adjustments in both directions have been made, crank the machine back and forth a few times to check that the locating notches return to the proper position at the end of each throw-bar stroke.

NOTE: The locating notches on the lock rod indicate only that the lock dog is in the center of the locking notches. Final adjustments must be made in accordance with AAR or railroad instructions.

Machine with Two Lock Rods and Two Point-Detector Rods

1. Connect and adjust the first pair of rods, one lock rod and one point-detector rod, in accordance with the preceding instructions.

2. Connect and adjust the second pair of rods. Be sure to start with the far switch point closed.

Before Placing Machine in Service

1. Lubricate the machine thoroughly.

2. Clean and oil the switch per railroad instructions.

3. Check all external wiring for proper connections, polarity, fusing, etc.

4. Check the clutch slipping current. The clutch of a 110-volt machine should slip at approximately 12 amperes; the clutch of a 24- to 32-volt machine, at 18 amperes. Instructions on how to test and adjust the clutch are given under "Friction Clutch".

5. Check the operation of the overload relay.

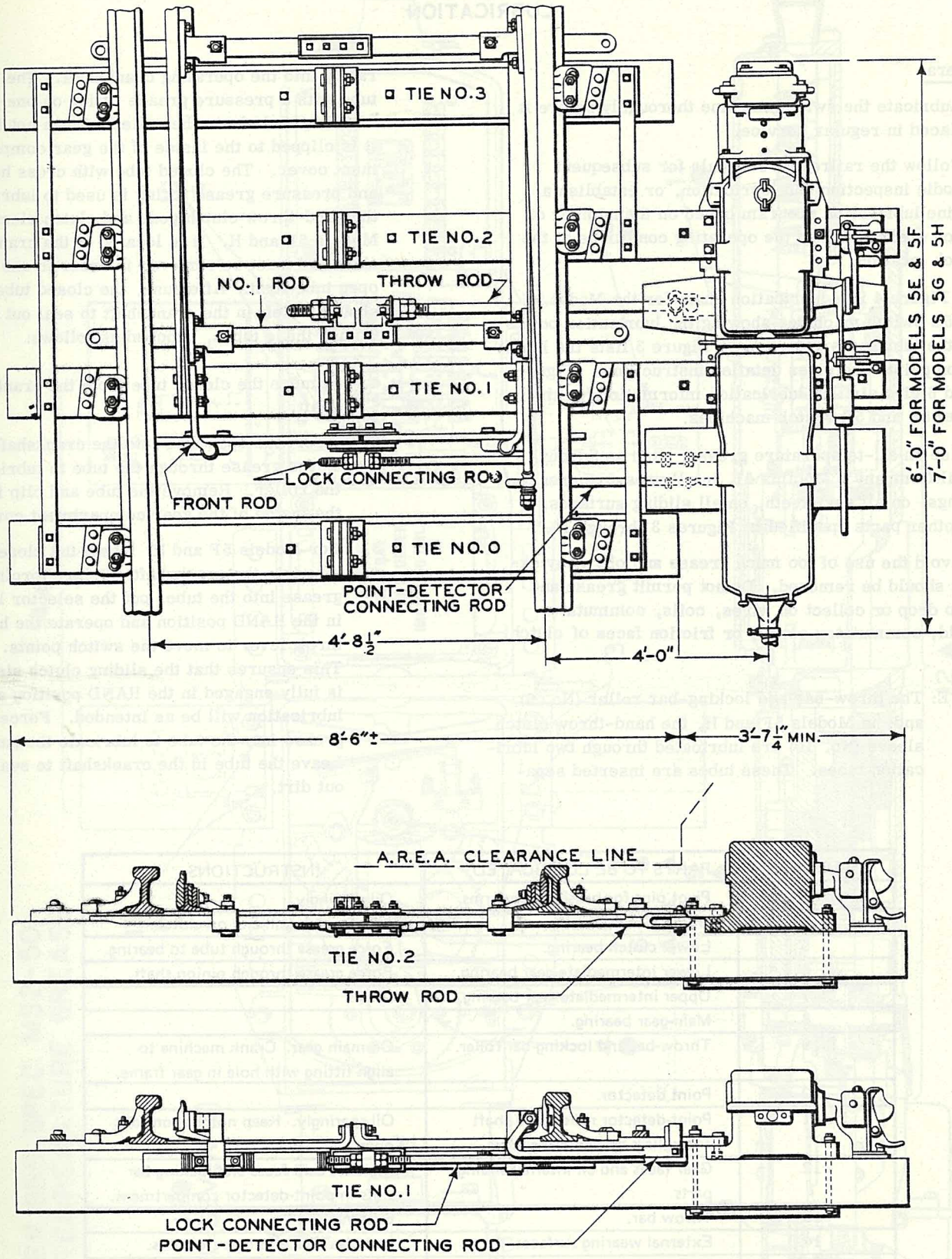


Figure 2. Typical right-hand single-switch layout with GRS hinged front rod.

LUBRICATION

General

Lubricate the switch machine thoroughly before it is placed in regular service.

Follow the railroad's schedule for subsequent periodic inspection and lubrication, or establish a routine lubrication program based on the number of switch operations and the operating conditions at the switch location.

Figure 4 is a lubrication chart for the Model 5E and 5G switch machines showing the lubrication points and the lubricants to be used. Figure 3 lists the lubrication points and gives detailed instructions. Figures 5 and 6 give similar lubrication information for the Model 5F and 5H switch machines.

Use an all-temperature grease, such as Socony Mobil Company's Mobilux #1, in all pressure grease fittings, on all gear teeth, on all sliding surfaces, and other parts specified in Figures 3 through 10.

Avoid the use of too much grease and oil. Any excess should be removed. Do not permit grease and oil to drop or collect on wires, coils, commutator shield, commutator cover, or friction faces of clutch.

NOTE: The throw-bar and locking-bar roller (No. 9) and, in Models 5F and H, the hand-throw clutch sleeve (No. 10) are lubricated through two lubrication tubes. These tubes are inserted separately into the operating crankshaft. The open tube with a pressure grease fitting on one end is used to lubricate the roller. When not in use, it is clipped to the inside of the gear compartment cover. The closed tube with cross holes and pressure grease fitting is used to lubricate the hand-throw clutch gear and clutch sleeve of Models 5F and H. It is located in the crankshaft and must be removed in order to use the open tube first. After use, the closed tube should be left in the crankshaft to seal out dirt. To use these tubes, proceed as follows:

1. Remove the closed tube from the crankshaft.
2. Insert the open tube into the crankshaft. Force grease through the tube to lubricate the roller. Remove the tube and clip it to the inside of the gear compartment cover.
3. For Models 5F and H, insert the closed tube into the crankshaft. Before forcing grease into the tube, put the selector lever in the HAND position and operate the hand-throw lever to move the switch points. This ensures that the sliding clutch sleeve is fully engaged in the HAND position and lubrication will be as intended. Force the grease into the tube to lubricate the parts. Leave the tube in the crankshaft to seal out dirt.

CHART NOS.	PARTS TO BE LUBRICATED	INSTRUCTIONS
3	Pivot pins for brush-holder arms.	Oil sparingly.
4	Upper clutch bearing.	Oil. Do not spill any on clutch.
5	Lower clutch bearing.	Force grease through tube to bearing.
6	Lower intermediate-gear bearing.	Force grease through pinion shaft.
7	Upper intermediate-gear bearing.	
8	Main-gear bearing.	
9	Throw-bar and locking-bar roller.	On main gear. Crank machine to align fitting with hole in gear frame.
10	Point detector.	
11	Point-detector rollers and shaft and rollers on centering arm.	Oil sparingly. Keep notches on rods open.
12	Gear faces and all internal sliding parts.	Includes cam faces and locking-bar slots in point-detector compartment.
13	Throw bar.	External.
14	External wearing surfaces.	Includes lock and detector rods.
15	Nut and threaded part of lock and detector rod.	Oil occasionally to prevent corrosion.
16	Padlock hasp hinge pins.	

Figure 3. Lubrication table for Model 5E and 5G.

14▲

● OIL PER GRS SPEC. MS2-50
▲ ALL-TEMPERATURE GREASE

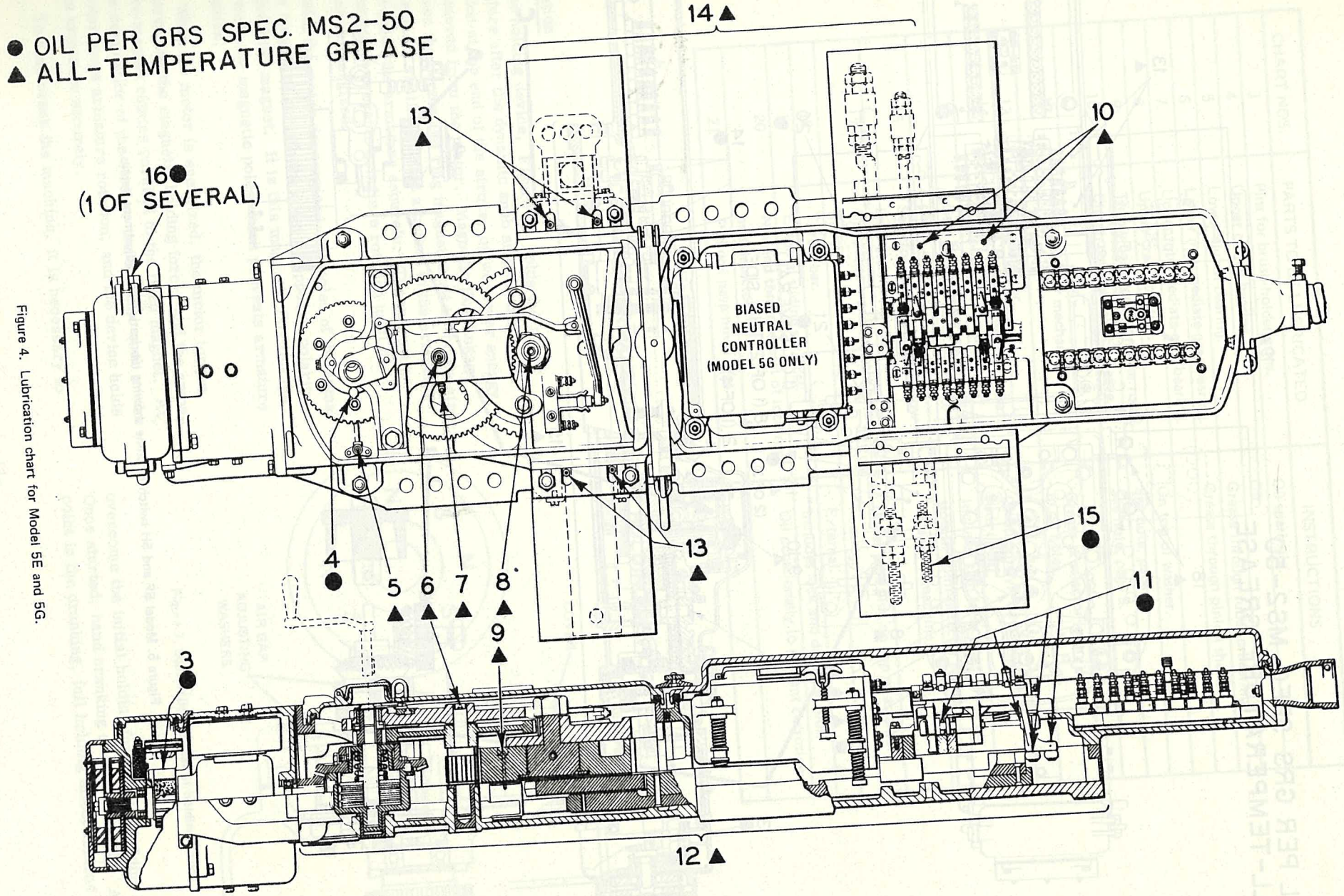


Figure 4. Lubrication chart for Model 5E and 5G.

● OIL PER GRS SPEC. MS2-50
▲ ALL-TEMPERATURE GREASE

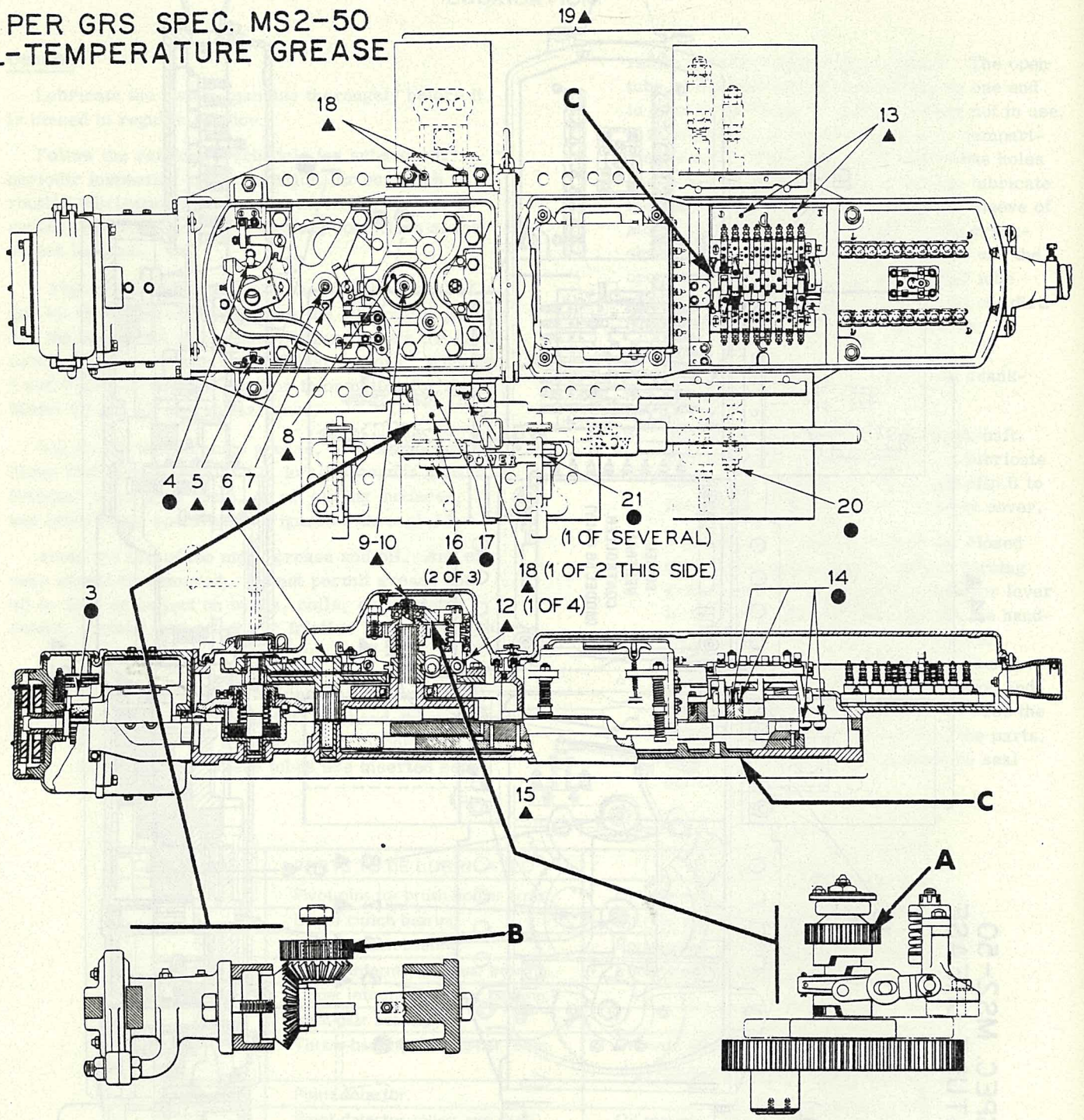


Figure 5. Model 5F and 5H switch machine showing lubrication and adjustment details.

CHAP

Operation

The holding devi
armature after the
rotation at the end
is removed from th
between the perman
cover and a similar
shaft holds the arm
detent effect preven
motor is energized.

With the motor
ture magnet align w
in the fixed magnet.
between the magnet
rotation.

When the motor
overcomes the mag
ture magnet rotates
the completion of th
motor stops armatu
the armature secur

To hand crank th

CHART NOS.	PARTS TO BE LUBRICATED	INSTRUCTIONS
3	Pins for brush-holder arms.	Oil sparingly.
4	Upper clutch bearing.	Oil.
5	Lower clutch bearing.	Grease through tube to bearing.
6	Lower intermediate-gear bearing.	Grease through pinion shaft.
7.	Upper intermediate-gear bearing.	
8	Upper crank bearing.	On top of washer.
9	Throw-bar and locking-bar roller.	See note, page 9.
10.	Clutch gear and clutch sleeve.	See note, page 9.
12	Clutch-shifter mechanism.	Grease at selector lever. Put oil in oil holes.
13	Point detector.	
14	Point-detector rollers and shaft, and rollers on centering arm.	Oil sparingly. Keep notches on rods open.
15	Gear faces and all internal sliding parts.	Includes cam faces and locking-bar slots in point-detector compartment.
16	Selector-lever and hand-throw lever assemblies.	Outside of machine.
17	Hand-throw and selector-lever shafts.	Under pipe plug on top of assembly housing.
18	Throw bar.	External.
19	External sliding surfaces.	Includes lock and detector rods.
20	Nut and threaded part of lock rod and detector rod.	Oil occasionally to prevent corrosion.
21	Padlock hasp hinge pins.	

Figure 6. Lubrication table for Model 5F and 5H.

CERAMIC PERMANENT MAGNET HOLDING DEVICE

Operation

The holding device, Figure 7, holds the motor armature after the dynamic snub stops armature rotation at the end of the stroke, or whenever energy is removed from the motor. Magnetic flux linkage between the permanent ring magnet fixed in the housing cover and a similar magnet attached to the armature shaft holds the armature securely. The magnetic-detent effect prevents armature rotation until the motor is energized.

With the motor deenergized, the poles of the armature magnet align with the poles of opposite polarity in the fixed magnet. It is this magnetic flux linkage between the magnetic poles which prevents armature rotation.

When the motor is energized, the motor torque overcomes the magnetic holding force, and the armature magnet rotates parallel to the fixed magnet. At the completion of the stroke, the dynamic snub on the motor stops armature rotation, and the device holds the armature securely.

To hand crank the machine, it is necessary to

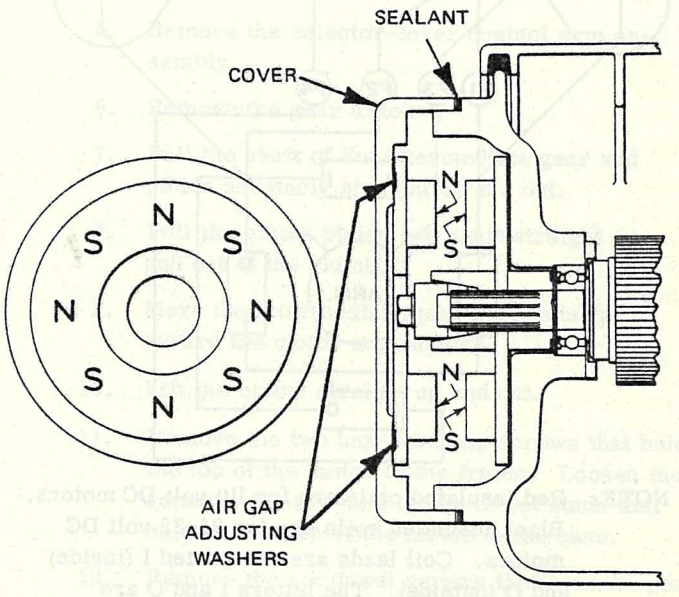


Figure 7. Schematic diagram of holding device.

overcome the initial holding force of the holding device. Once started, hand cranking continues easily. At any point in the cranking, full holding effect returns when-

ever cranking stops or slows down sufficiently to permit the magnetic flux linkage to overcome the cranking torque.

Inspection

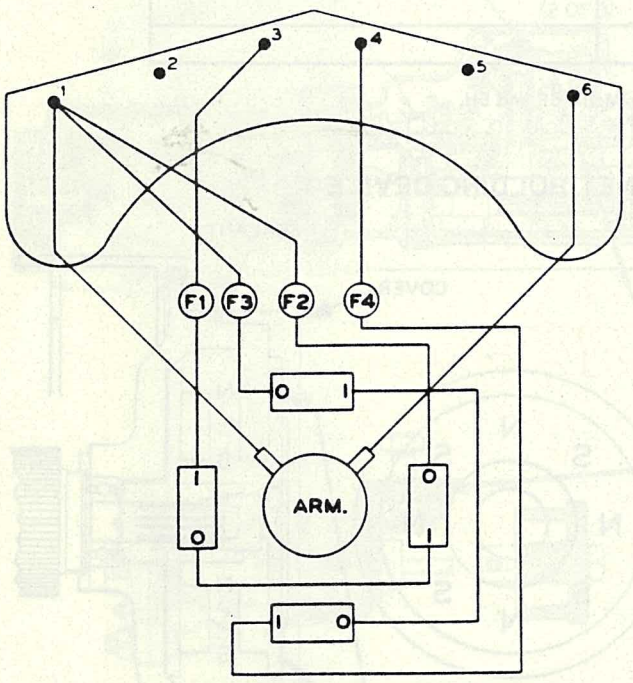
Once a year, check the holding device as follows:

1. Remove the cover.
2. Check that all screws and nuts are tight.
3. Check that the armature and attached magnet rotate freely.
4. There should be no end play in the armature shaft. The wavy washer in the case, adjacent to the ball bearing, automatically eliminates armature end play.
5. The gasket washers between the cover and the front bearing housing are for adjusting the air gap between magnets. The air gap establishes locked torque on the armature at 1.25 to 1.75 foot pounds.
6. Apply sealant (Permagum or similar) to the surface of the cover which mates with the holding device and replace the cover.

MOTOR

Motor Field Connections

Motors are furnished with series split-connected field coils. Figure 8 shows the motor connection diagram as the motor is viewed from the commutator end. The internal arrangement of the field coils does not permit changes in the field coil connections.



NOTE: Red insulated coils are for 110 volt DC motors. Black insulated coils are for 24-32 volt DC motors. Coil leads are designated I (inside) and O (outside). The letters I and O are molded into coil insulation.

Figure 8. Motor connection diagram (series split field).

Dynamic Snubbing

At the completion of each stroke, the overrun of the motor generates a dynamic current. This current flows through a low-resistance circuit. In Models 5E and 5F, the circuit includes the snub resistor lead, one-half of the snub rectifier, point detector contacts, and the opposite field coils of the motor. In the Models 5G and 5H, the circuit includes the snub resistor lead, one-half of the snub rectifier, the snub contact in the controller, and the opposite field coils of the motor. Flux generated in this circuit quickly slows and stops armature rotation.

Commutator Shield

The transparent commutator shield prevents condensation, water, or dirt from falling on the commutator.

1. Keep the nuts tight that hold the shield in place.
2. To remove the shield, loosen the nuts and slide the shield toward the armature.
3. Keep the shield in place all year.

Commutator Cover

The silicone-treated, moisture-repellent commutator cover keeps moisture off the commutator.

1. At switch locations where frost is not encountered, remove this cover. It is not required and should not be used.
2. At locations where frost is encountered, the cover should be used only during the frost season. Remove the cover when all danger of frost is past. Replace the cover at the start of the next frost season.

If the used cover is still in good condition, clean it thoroughly with a suitable brush or air blast after removal. The cover will then be clean and ready for reuse at the start of the next frost season. If the used cover is not in good condition, discard it. Put a new

one around the commutator at start of the next frost season.

Commutator and Brushes

1. After a new or reconditioned motor has been in service, the area which comes in contact with the brushes should become coffee-colored and highly polished.
2. Keep the commutator smooth and free of grease or oil.
3. Twice a year, remove any carbon dust around the commutator end of the armature, in the undercuts, in the brush holders, and on the sides of the brushes. If the commutator cover is used, this can be done conveniently when the cover is removed at the end of the frost season, and again before it is replaced at the start of the next frost season.
4. Brushes should slide freely in the holders and seat fully on the commutator. Brush pressure should be 1-1/4 to 1-3/4 pounds.
5. New brushes must be of the same grade as those originally used. Fit and seat each new brush carefully to the commutator. Use No. 00 sandpaper. Never use emery cloth on the commutator or brushes.

GEARING

Models 5E and 5G — To Remove Gears

1. Disconnect the motor energy.
2. Remove the crank-contact connecting rod.
3. Remove the gear bracket.
4. Remove the clutch pinion and shaft. Pull this assembly straight up and out of the clutch body.
5. Lift out the intermediate gear.
6. Lift out the clutch body complete.
7. Loosen (not remove) the two nuts on the dowel studs that secure the bottom of the motor to the switch machine base.
8. Remove the two hex-head cap screws that hold the top of the motor to the gear frame.
9. Disconnect the wires on the crank contact.
10. Remove the six hex-head dowel screws that hold the gear frame to the base.
11. Lift up and remove the gear frame.
12. Remove the hex nut from the bearing stud and drive the stud out. Remove the main gear from the gear frame.

Models 5E and 5G — To Reassemble Gears

Before reassembly, wipe all parts clean and cover all bearing surfaces with a light coating of the lubricant recommended for the particular part.

Apply a weatherproofing compound between the motor, the base, and the gear frame, and between the gear frame and the contact-compartment frame.

To reassemble the gears, reverse the disassembly procedure. Lubricate the machine after assembly.

Models 5F and 5H — To Remove Gears

1. Disconnect the motor energy.
2. Crank the machine to the center (midstroke) position. In the center position, the arrow on the washer on the end of the operating crankshaft is aligned with the centerline of the machine.
3. Loosen and turn the wire clips.
4. Remove the crank and the selector-lever contact block assemblies without removing the wires.
5. Remove the selector-lever contact arm assembly.
6. Remove the gear bracket.
7. Pull the shaft of the intermediate gear and pinion assembly straight up and out.
8. Pull the clutch pinion and shaft straight up and out of the clutch.
9. Move the intermediate gear horizontally toward the motor and remove.
10. Lift the clutch straight up and out.
11. Remove the two hex-head cap screws that hold the top of the motor to the frame. Loosen (not remove) the two nuts on the dowel studs that hold the bottom of the motor to the base.
12. Remove the six dowel screws that hold the gear frame to the base.
13. Remove the gear frame with the dual-control mechanism attached.
14. Remove the main gear and the operating crank from the gear frame. If the dual-control mech-

anism is to be retimed when the machine is reassembled, simply remove the nut and washers from the top end of the operating crank and pull the crank down and out.

To remove the gear and crank without having to retime the dual-control mechanism when reassembling, proceed as follows:

a. Remove the hand-throw lever extension.

b. Stand the gear frame unit on its motor end.

c. Place the selector lever in the HAND position. The hand-throw lever is in a downward position.

d. If necessary, rotate the main gear and crank until the clutch sleeve engages the clutch gear.

e. Remove the nut and washer from the top of the crankshaft.

f. Carefully note the alignment of the crank with respect to the gear frame. It must be replaced in the same alignment.

g. Force the crank out. Follow it part way through with a tool that just goes through the top bearing. Hold the tool in position to prevent the clutch gear from unmeshing from the idler gear.

h. With the crank removed, remove the main gear.

Models 5F and 5H — To Reassemble Gears

Before reassembly, wipe all parts clean and cover all bearing surfaces with a light coating of the lubricant recommended for the particular part.

Apply a weatherproofing compound between the motor, the base, and the gear frame, and between the gear frame and the contact-compartment frame.

To reassemble the gears of a Model 5F or 5H switch machine, proceed according to the following instructions. After assembly is completed, lubricate the machine thoroughly.

1. Replace the main gear and crank in the gear frame. Be sure to insert the crank in the same alignment with respect to the gear frame as it was before removal. This ensures that the same splines of the crank and clutch sleeve are engaged with one another. With the crank in place, and the washers and nut replaced on the end of the crank, put the selector lever into the POWER position and rotate the gears until the crank points straight up. See that the prick-punch mark on the uppermost raised cam surface of the clutch sleeve is on the centerline of the machine. This means that the splines are properly engaged.

   NOTE: If the main gear and operating crank are removed and replaced according to the preceding instructions, it should not be necessary to retime the dual-control mechanism. If retiming is necessary, for any reason, follow the instructions on page 23, beginning with step number 10.

2. Replace the gear-frame assembly. Check the alignment of parts. Check that the operating crank is in proper position for the throw bar and locking bar. Replace the six dowel screws that hold the frame to the base. Tighten these screws finger-tight. Replace the motor cap screws, finger-tight.

3. Set the clutch in the base.

4. Place the intermediate gear in its approximate position. Slide the gear horizontally toward the point detector and lower it in place.

5. Replace the shaft in the intermediate gear and pinion assembly.

6. Replace the clutch pinion and shaft in the clutch.

7. Replace the gear bracket.

8. With the selector lever in the POWER position, operate the machine with the crank. Observe that all parts rotate freely, and function as intended. If so, tighten the dowel screws, and the screws and nuts that hold the motor to the frame and base.

9. Replace the crank and the selector-lever contact block assemblies.

10. Put the wire clips back to their original position.

11. Operate the machine with the hand-throw lever. If it operates correctly, connect the motor energy wires and operate it with power.

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To Test Clutch

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5. Read the
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Friction Clutch	24-
4 Disc	18
6 Disc	—

Figure 9. Current
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To Adjust Clutch

To adjust the c
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FRICTION CLUTCH

The friction clutch in the gear train absorbs any shock encountered in switch operation. The clutch is adjusted to slip when the motor-operating current exceeds a specified value. Initial and periodic tests of clutch operation are desirable.

To Test Clutch

Test the clutch when placing the machine in service and at scheduled intervals thereafter. Figure 9 shows the motor currents at which the clutches are adjusted to slip at the factory. Slipping current may be varied to meet standard railroad specifications.

To test the setting of the clutch, proceed as follows:

1. Place an obstruction between the switch point and the rail.
2. Connect an ammeter in series with the motor energy.
3. Shunt out the operating winding of the overload relay.
4. Operate the switch against the obstruction.
5. Read the motor current as the clutch slips.
6. Remove the shunt on the overload relay.
7. Remove the obstruction from between the switch point and the rail.

Friction Clutch	24- to 32-volt d-c	110-volt d-c
4 Disc	18 Amperes	———
6 Disc	———	12 Amperes

Figure 9. Current values at which friction clutches are adjusted to slip (factory adjustments).

To Adjust Clutch

To adjust the clutch to slip at the desired current, proceed as follows:

1. Crank the machine to the unlocked position.
2. Back off the setscrew that holds the clutch adjusting nut. See Figure 10.
3. Insert a 5/16-inch diameter pin through the hole in the gear bracket and into the hole in the clutch adjusting nut. The pin holds the adjusting nut when the hand crank is rotated.

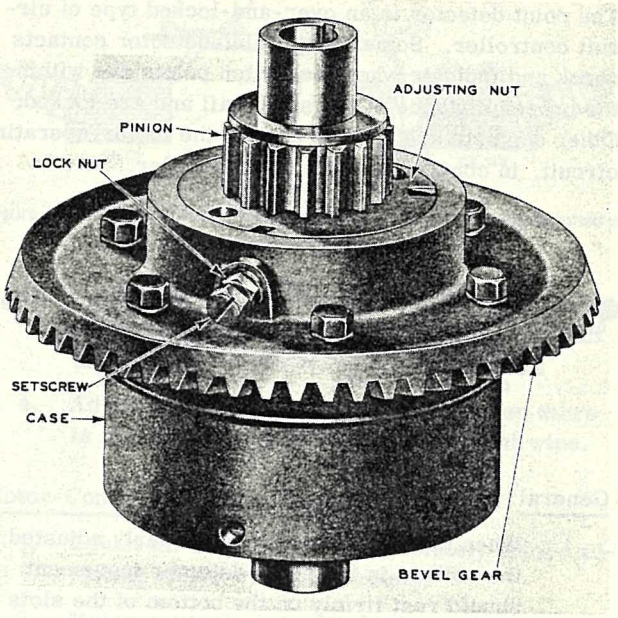

Figure 10. Friction clutch.

4. To increase the slipping current, rotate the hand crank counterclockwise.

   NOTE: If the clutch is so loose that friction is not sufficient to tighten the adjusting nut, rotate the clutch housing until friction increases enough to permit adjustment with the hand crank.

5. To decrease the slipping current, rotate the hand crank clockwise.
6. Position the notch in the adjusting nut opposite the setscrew. Tighten the setscrew.
7. Shunt out the operating winding of the overload relay. Test the clutch again to determine the slipping current. Remove the shunt on the overload relay.
8. After adjusting the clutch, check the operation of the overload relay.

Models 5F and 5H — To Remove Clutch

The clutch in the Models 5F and 5H switch machines can be removed without disassembling the dual-control mechanism. To remove the clutch, follow the instructions under "Models 5F and 5H — To Remove Gears" on page 13, steps 1 through 10.

POINT DETECTOR

The point detector is an over-and-locked type of circuit controller. Some of the point-detector contacts check and indicate when the switch points are within the proper distance of the stock rail and are locked. Other contacts are used to control the motor-operating circuit, in conjunction with the controller.

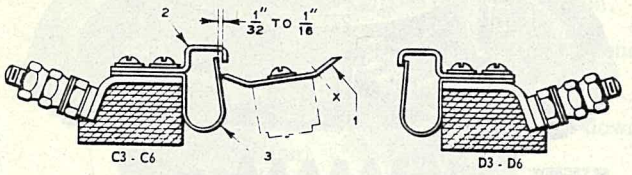

Figure 11. Normal and reverse contacts.

General

1. When the point detector is properly adjusted, the rollers in the point-detector movement should rest firmly on the bottom of the slots in the point-detector rods in both the normal and reverse position.

2. The proper fully-made position for normal and reverse contacts is shown in Figure 11. Figures 12 and 13 show this position for the shunt and motor-control contacts.

3. The contact pressure for normal and reverse contacts, measured very near the point of contact, should be 2-1/2 to 3 pounds.

4. The contact pressure for shunt contacts in Models 5E and F, measured very near the point of contact, should be 2-1/2 to 3 pounds, and is adjustable. The contact pressure of the motor-control and shunt contacts of Models 5G and H is determined by the coil spring and the contact opening. This pressure is not adjustable.

5. To decrease the pressure of a normal, reverse, snub, or Models 5E and F shunt contact, bend the U-shaped spring in until it has taken a set which gives the desired pressure. To increase the pressure, release the U-shaped spring from its stop and bend the spring out.

Model 5E and F Normal and Reverse Contacts C5, C8, D1 and D4, and Snub Contacts C3, C4, D5 and D6 (Figure 11) Model 5G and H C3, C6, D3, and D6

1. Adjust the contacts on each side to make and break at the same time.

2. With the contacts made, the distance between U-shaped spring 3 and front stop 2 should not be more than 1/16 inch or less than 1/32 inch.

To adjust this distance for all contacts, loosen the contact block assembly and move it in or out as required. Tighten the assembly after the adjustment.

To adjust an individual contact, bend finger 1 at point X.

Model 5E and F Shunt Contacts C6, C7, D2 and D3 (Figures 12 and 13)

The switch machine received from the factory has shunt strips A, Figure 12, connected across contacts C6-D3 and C7-D2. Shunt strips A are used only in a polarized repeater relay circuit. To use a neutral repeater relay circuit, remove shunt strips A and assemble shunt strips B between contacts C6-C7 and D2-D3, Figure 13, Shunt strips B, supplied with each new machine, are in the cloth bag containing the motor ventilators.

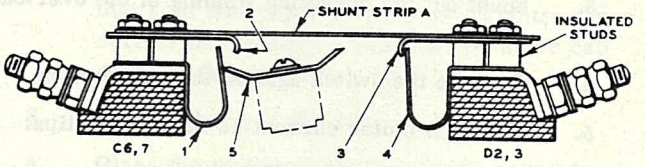

Figure 12. Shunt contacts, polarized repeater relay circuit.

When the switch machine is operated, the first or unlocking movement of the locking bar simultaneously opens the snub contacts and either the normal or reverse contacts, depending on the direction of operation.

Immediately after these contacts are opened, the shunt contacts are closed. With the machine unlocked, or if the point-detector rod is out of adjustment, there is a shunt on the repeater relay circuit. The shunt prevents pickup of the repeater relays so that any extraneous energy which may be present cannot cause a false indication.

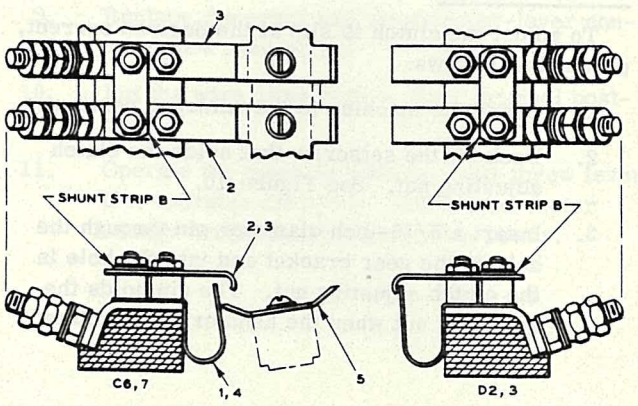

Figure 13. Shunt contacts, neutral repeater relay circuit.

In a polarized repeater relay circuit using shunt strips A, Figure 12, the shunt is closed through terminal post C6, U-shaped spring 1, front stop 2, shunt strip A, front stop 3, U-shaped spring 4, and opposite terminal post D3. A similar shunt arrangement exists between posts C7 and D2.

In a neutral repeater relay circuit using shunt strips B, Figure 13, the shunt is closed through terminal post C6, U-shaped spring 1, front stop 2, shunt strip B, front stop 3, U-shaped spring 4, and adjacent terminal post C7. A similar shunt arrangement exists between posts D2 and D3.

After the switch points have been properly positioned, the locking movement of the locking bar permits the point detector to complete its movement, Shunt contact finger 5, Figure 12 or 13, which is attached to the movable block, moves U-shaped spring 1 about 1/16 inch before the other section of this contact finger closes the normal or reverse contact. Thus, the shunt on the repeater relay circuit is removed before the normal or reverse contacts and the snub contacts are closed.

To summarize —

1. Normal or reverse and snub contacts must be open before the shunt contacts close.
2. Shunt contacts must be open about 1/16 inch before normal or reverse and snub contacts close.

Model 5G and H Shunt Contacts C7, C8, D1 and D2 (Figure 13)

The normal and reverse contacts should be completely adjusted before attempting to adjust the shunt contacts.

1. The shunt contacts should not make before the normal and reverse contacts are open, and the normal and reverse contacts should not make before the appropriate shunt contact is open.
2. The contact opening of the shunt contact should be approximately 7/32 inch. This opening can be adjusted by loosening screw 2, lifting the adjuster tip out of its hole, and moving contact 1 in or out as required. Retain this adjustment by setting the adjuster tip in a new hole and tightening the screw.

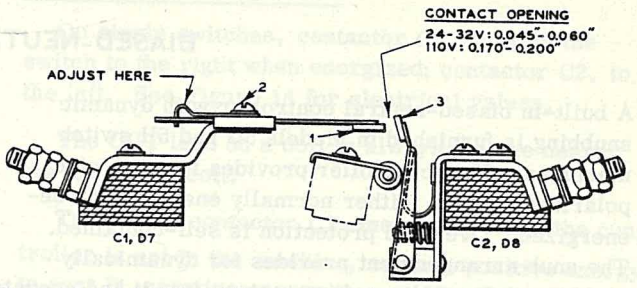

Figure 14. Model 5E and F motor-control contacts shown positioned as related snub contact just makes.

3. Contact tip 1 should be aligned with contact tip 3 and should make at least 75 percent of its full width when the contact is closed.
4. Adjust the tip of the movable contact so there is from 1/64-inch to 1/32-inch contact wipe.

Motor-Control Contacts (Figures 14 and 15)

1. Adjust all other contacts completely before adjusting motor-control contacts.
2. Motor-control contacts of a 24- to 32-volt machine should be open from 0.045 inch to 0.060 inch when the related snub is normal or reverse contact just makes.

   In a 110-volt machine, this opening should be from 0.170 inch to 0.200 inch. To adjust this distance, loosen screw 2, lift the adjuster tip out of the hole and move contact 1 in or out as required. After adjustment, set the adjuster tip in a new hole and tighten the screw.
3. The contact pressure of motor-control contacts is governed by the contact opening and coil spring design. The contact pressure is not adjustable.
4. Adjust the tip of the movable contact so that there is from 1/64-inch to 1/32-inch contact wipe.

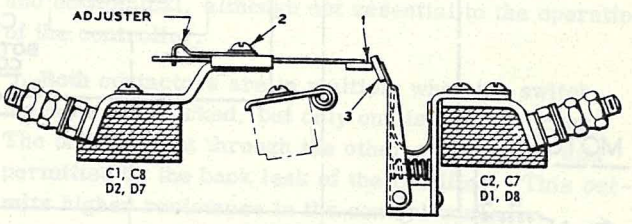

Figure 15. Model 5G and 5H shunt and motor-control contacts.

BIASED-NEUTRAL CONTROLLER

A built-in biased-neutral controller with dynamic snubbing is furnished in Models 5G and 5H switch machines. This controller provides for two-wire polarized control, either normally energized or de-energized. Overload protection is self-contained. The snub arrangedment provides for dynamically snubbing the switch machine motor after it has operated and locked the switch.

The controller consists of two biased-neutral contactors, (C1 and C2), an overload relay, a snubbing contact operated by the contactors, a snubbing rectifier, and a snub resistor lead. The components are housed in an aluminum case provided with a terminal board.

Operation of Biased-Neutral Controller

Typical wiring diagrams for the Models 5G and 5H switch machines with biased-neutral controllers are shown in Figures on pages 32 and 33 respectively. A simplified diagram of the switch machine circuit with snubbing arrangement is shown in Figure 16.

Referring to Figure 16, operation is as follows:

1. When the switch machine is to operate to the left, positive control energy is applied to the NWR wire and negative control energy to the WR wire. This causes contactor C2 to be energized. When contactor C2 picks up, the snub contact opens. Contactor C2 closes its front contact and, through the centering device, closes the back contact of contactor C1. This completes the motor circuit and operating energy flows from terminal 5, through the front contact of C2, the reverse field of the motor, the armature, the crank contact, the operating coil of the overload relay, and the back contact of contactor C1 to negative.

As the switch machine unlocks, point-detector contacts 7D-2C close. The machine continues to operate to the left. When the machine completes its stroke, point-detector contacts 1C-8D open, deenergizing contactor C2 and opening the motor circuit. The contactor armatures return to their normally centered position and the snub contact closes. The motor armature continues to revolve, generating a dynamic current which flows from field coil N through terminals 4 and 9, one half of the snub rectifier, the snub resistor lead, the the snub contact, terminals 12 and 7, the crank contact, terminal 6, the armature, terminal 1, and back to coil N.

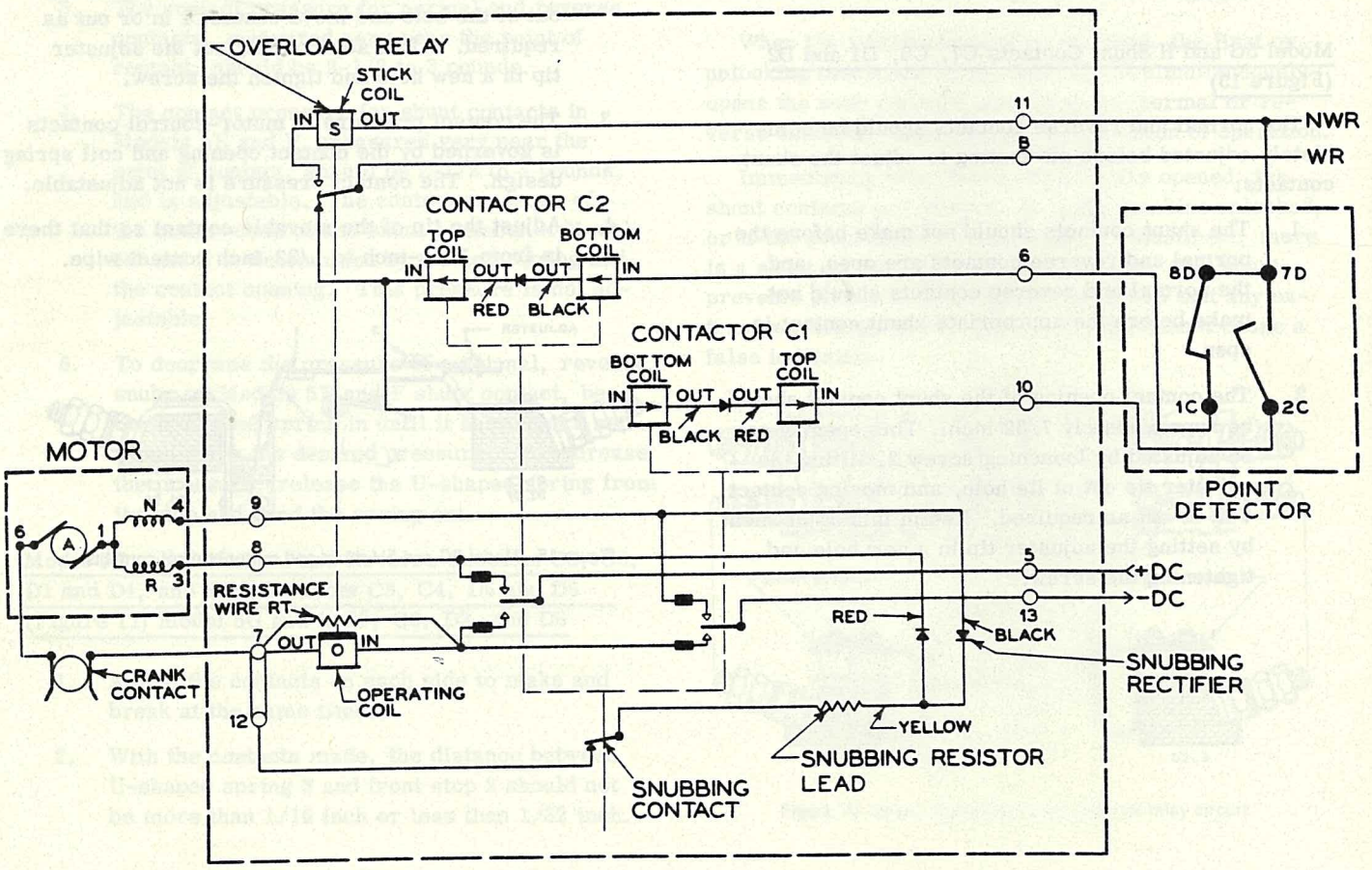

Figure 16. Switch machine circuit with snubbing arrangement (simplified).

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Figure 17 shows
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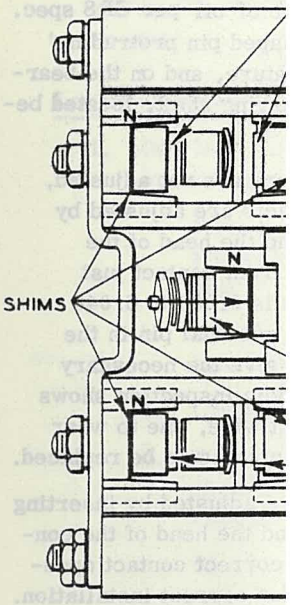


Figure 17. Snub and front-ba
biased-neutral con

2. When the switch machine is to operate to the right, positive control energy is applied to the WR wire and negative control energy to the NWR wire. This causes contactor C1 to be energized. When contactor C1 picks up, the snub contact opens. Contactor C1 closes its front contact and through the centering device closes the back contact of contactor C2 (point-detector contacts 7D-2C were closed and contacts 1C-8D were opened during the operation of the machine to the left). This completes the motor circuit and operating energy flows through the motor in a direction to operate the machine to the right. As the machine completes its stroke, contacts 7D-2C open, deenergizing contactor C1 and opening the motor circuit. The contactor armatures return to their normally centered position and the snub contact closes. The overrun of the motor armature again generates a dynamic current which now flows from field coil R through terminal 1, the armature, the crank contact, terminals 7 and 12, the snub contact, the snub resistor lead, the other half of the snub rectifier, terminals 8 and 3, and back to coil R. The dynamic snub is just as effective if the contactors are deenergized in midstroke, regardless of the direction in which the switch machine is operating.

Construction of Contactors

The extra-heavy-duty snub and contactor contacts are equipped with permanent magnet blowouts.

Figure 17 shows the snub and front-back contact structure of biased-neutral controllers as provided in Models 5G and 5H switch machines.

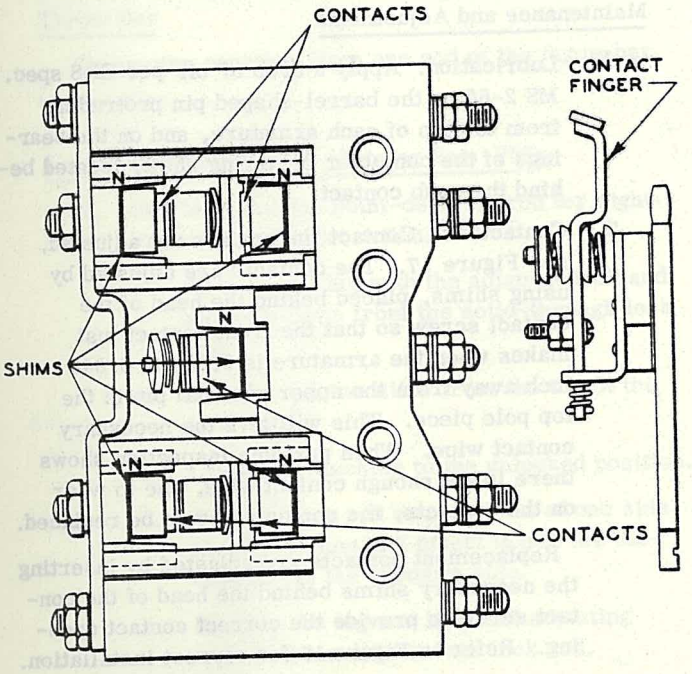


Figure 17. Snub and front-back contact structure and contact finger of biased-neutral controllers on Models 5G and 5H switch machines.

Tests and Operating Values

On single switches, contactor C1 operates the switch to the right when energized; contactor C2, to the left. See Figure 18 for electrical values.

The OUT lead on a coil is always the one nearer the tag on the coil.

To operate contactor C1 electrically when the controller is not in the machine, connect positive energy to post B, negative energy to post 10. To operate contactor C2, connect positive energy to post 6, and negative energy to post B.

Nominal Control Voltage	Resistance (Ohms)		Working Current	Dropaway Current
	Each Contactor	Rectifier (Forward)	Not to Exceed	Not Less Than
10-12	36	7 (approx.)	0.140	0.026
24-32	250	30 (approx.)	0.055	0.010

Figure 18. Operating valves of biased-neutral contactors at 70° F.

Centering Device

The centering device connects the two contactor armatures. When either contactor is energized, this device mechanically closes the back contact of the other contactor and opens the snub contact. When both contactors are deenergized, the device mechanically centers the two contactor armatures between their front and back contacts, and also closes the independent snub contact located between C1 and C2.

Blocking Rectifier

The blocking rectifier permits a relatively high energy input to the contactor. As soon as the motor-control contacts within the switch machine have operated in response to the energization of the control circuit, the energy input to the contactor is cut down to the amount permitted by the back leak of the rectifier. This makes normally energized control practical and economical, although not essential to the operation of the controller.

Both contactors are in multiple when the switch machine is unlocked, but only one is taking current. The only current through the other contactor is that permitted by the back leak of the rectifier. This permits higher resistance in the control wires.

The blocking rectifier is connected between the coils of each biased-neutral contactor to protect it against the effects of lightning.

Snub Rectifier

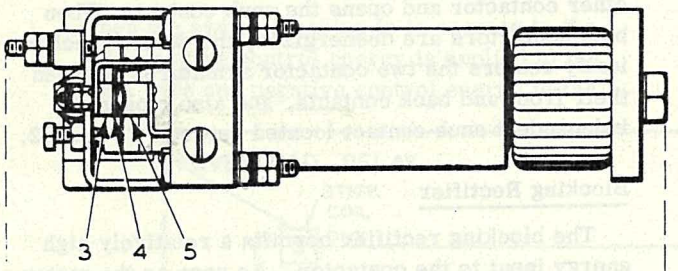
The half-wave snub rectifier unit consists of two sections, one for each contactor. The rectifier establishes a low resistance snub circuit in the proper direction for snubbing the switch machine motor at

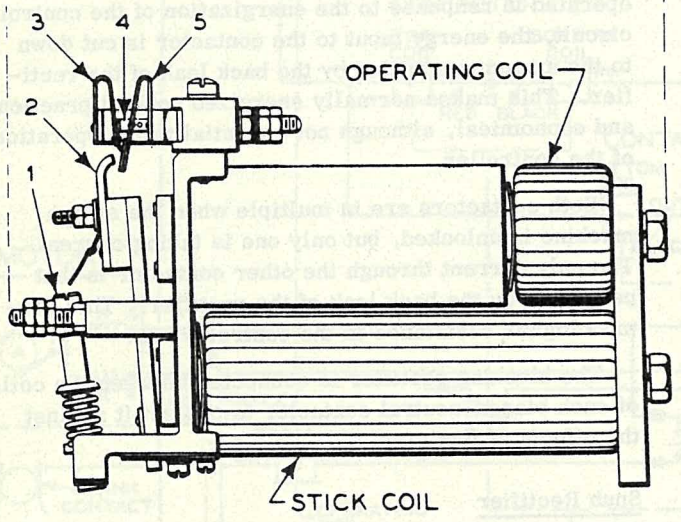
the end of the stroke in both the normal and reverse position. The snub resistor lead is connected in series with the snub rectifier.

Operation of Overload Relay

The overload relay, Figure 19, operates to release the contactors which in turn open the motor circuit whenever an overload is encountered. Operating coil O, Figure 16, is connected in multiple with external resistance wire RT. Normally, most of the operating current flows through the resistance wire and therefore, there is not sufficient current flowing in operating coil O to pick up the relay. High current, such as the motor will draw if there is an overload, heats resistance wire RT and increases its resistance. This action causes sufficient current to flow through operating coil O to pick up the relay. Once up, the armature will be held up by stick coil S until the control circuit is interrupted or reversed.

The action of the relay is retarded by a copper slug and washers so that it will not pick up in response to the momentary surges of current that occur when starting or reversing the motor. When the overload relay picks up, it removes energy from contactors C1 and C2.





NOTE: To increase pickup time, turn slotted-head nut 1 clockwise; to decrease turn counter-clockwise.

Figure 19. Overload relay.

To Remove Controller

It is recommended that the controller be changed out as a unit, if necessary, rather than changing out any of its components separately. Proceed as follows:

1. Open the disconnect switch on the terminal board.
2. Remove elastic stop nuts from studs.
3. Lift out controller case with wiring attached.
4. Disconnect wiring. Wires are made up in a cable and can be removed from the one controller and replaced on the other in a group, without error.

To Replace Controller

To position the controller in the switch machine, proceed as follows:

Place the switch machine in its unlocked position. The bottom of the controller should just clear the lock dog. The controller should be free to move in any direction to allow for vibration, but it must not touch other parts of the machine, except through the resilient mounting springs. After the controller is first installed, and periodically thereafter, check as follows:

1. Make sure that the wires are arranged to allow for free movement of the controller.
2. Make sure that the stop nuts are tight.
3. Operate the machine to its fully unlocked position and check that the controller case does not touch the dog on the locking bar.

Maintenance and Adjustment

1. Lubrication: Apply a drop of oil per GRS spec. MS 2-50 on the barrel-shaped pin protruding from the top of each armature, and on the bearings of the contactor centering shaft, located behind the snub contact.
2. Contactors: Contact fingers are not adjusted, see Figure 17. The contacts are adjusted by using shims, placed behind the head of the contact screw so that the front contact just makes when the armature is 0.030 to 0.040 inch away from the upper residual pin in the top pole piece. This will give the necessary contact wipe. When periodic inspection shows there is not enough contact wipe, due to wear on the contacts, the contacts should be replaced.

Replacement contacts are adjusted by inserting the necessary shims behind the head of the contact screw to provide the correct contact opening. Refer to Figure 17 for correct installation.

The permanent magnet blowouts for the snub and contactor contacts are stamped N to indicate which is the north pole of each magnet. If these magnets should be removed, be sure to reassemble them in their original positions with respect to magnet polarity. See Figure 17.

Shims are provided behind the upper bearing support of the contactor centering shaft. These shims permit the centering device to be properly positioned so that the back contact of one contactor will make at the same time, or slightly before, the front contact of the other contactor.

Contact pressure should not be less than 256 grams (9 ounces) and contact resistance should not exceed 0.1 ohm. The proper electrical values are given in Figure 18. If working current is too high, the horizontal spring below the snub contact is too tight, and should be adjusted as required by changing the position of the nut holding it in compression.

3. Blocking Rectifier: The blocking rectifier is connected between the coils of each biased-neutral contactor to protect it against the effects of lightning. To test the blocking rectifier, place a milliammeter in the control circuit. In either the normal or reverse position, the current should not exceed 0.025 ampere when the machine is fully over and locked.

   NOTE: Do not operate machine while test is in progress.

4. Overload Relay: Overload relays are factory adjusted to pick up in approximately 3 seconds after the clutch begins to slip. There must be at least 0.010-inch clearance between spring 3 and stop 4 when the relay is deenergized, see Figure 19. When the relay is fully picked up, spring 3 must rest against stop 4. Deenergized contact pressure should be 90 to 100 grams. This pressure is measured by placing a 0.010-inch feeler between spring 3 and stop 4, and applying pressure to the contact on spring 5 until the contact opens. The contact opening with the armature picked up should be 0.030 to 0.040 inch. Adjustment of the contact opening is made by carefully bending arm 2.

   Check the operation of the overload relays approximately once every three months, or when any changes in clutch settings are made. This is accomplished by blocking the action of the switch and then operating the machine, noting the length of time from when the machine encounters the obstruction and until the overload relay picks up. Three to a maximum of ten seconds for pickup is recommended and some variation in time for pickup may be expected between tests in two directions. To increase the pickup time of the overload relay, turn slotted-head nut 1 clockwise; to decrease the pickup time turn counterclockwise.

TO CHANGE FROM LEFT- TO RIGHT-HAND OPERATION OR VICE VERSA

Throw Bar

Change the coupling from one end of the throw bar to the other.

Lock and Detector Rods (Catalog Sec. P85)

1. One lock and one point-detector rod for right- or left-hand single switch.

   a. Remove the lug with the adjacent lock and adjusting nuts from the solid-through lock rod.

   b. Remove the two clips from the top of the lock rod.

   c. Crank the machine to the unlocked position.

   d. Pull the lock rod as a unit out of one side of the machine and insert it into the machine from the opposite side.

   e. Replace the lug and lock and adjusting nuts on the solid-through lock rod.

   f. Replace the clips on the top of the lock rod.

      CAUTION: If the No. 1 set of lock rods is equipped with older style arms (clips) as shown in Figure 20c, it is extremely important that they be installed in the proper position. Ensure that the extended, raised portion of each arm, when repositioned on the No. 1 set of lock rods, faces the point detector end of the machine (raised portion of arm up).

   g. Remove the lug with the adjacent lock and adjusting nuts from the solid-through point-detector rod.

   h. Pull the point-detector rod as a unit out of one side of the machine and insert it into the opposite side. To facilitate this operation, raise the point-detector movement

slightly by prying it upward with a bar rested on the top of the lock rods.

i. Replace the lug and lock and adjusting nuts on the solid-through point-detector rod.

2. Two locks and two point-detector rods — for right-and left-hand double slip switch.

a. Remove lugs with the adjacent lock and adjusting nuts from the solid-through lock and point-detector rods.

b. Remove the two clips from the top of each set of lock rods. Figure 20a shows the type of clip used on the No. 2 set of lock rods (the No. 2 set of lock rods is nearer the point-detector end of the machine).

c. Crank the machine to the unlocked position.

d. Pull the lock and point-detector rods as a group out of one side of the machine and insert them into the machine from the opposite side. The set of rods previously nearer the motor end of the machine is now nearer the wire-entrance end.

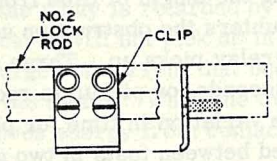


Figure 20a. Lock rod clip on No. 2 lock rod in machine at double-slip switch.

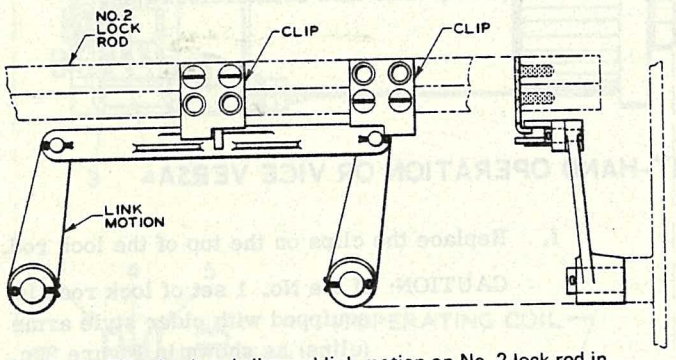


Figure 20b. Lock rod clips and link motion on No. 2 lock rod in machine at movable-point frog.

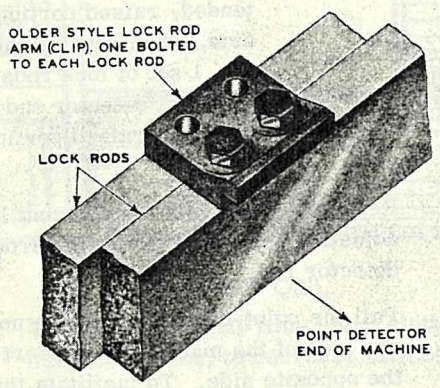


Figure 20c. Older style lock rod arm (two required per machine).

e. Replace the lugs and the lock and adjusting nuts on the solid-through lock and point-detector rods.

f. Replace the two clips on the top of each set of lock rods.

CAUTION: If the No. 1 set of lock rods is equipped with older style arms (clips) as shown in Figure 20c, it is extremely important that they be installed in the proper position. Ensure that the extended, raised portion of each arm, when repositioned on the No. 1 set of lock rods, faces the point detector end of the machine (raised portion of arm up).

3. Two locks and two point-detector rods — movable-point frog.

NOTE: Point-detector rods of a machine used on a movable-point frog are not interchangeable L-H to R-H. When the direction of the machine is changed, different sets of point-detector rods must be used.

a. Remove the lugs, lock and adjusting nuts, and clips from the rods. Figure 20b shows one pair of clips mounted on the No. 2 set of lock rods.

b. Crank the machine to the unlocked position.

c. Pull the lock and point-detector rods as a group out of one side of the machine.

d. Insert the two sets of lock rods as a group into the machine from the opposite side.

e. Insert two replacement sets of point-detector rods designed for the desired direction of operation, into the machine. Previously used rods cannot be reused.

f. Replace the lugs and lock and adjusting nuts on the solid-through lock and point-detector rods.

g. Check that the link motion is in the proper position and replace the two clips on the top of each set of lock rods.

CAUTION: If the No. 1 set of lock rods is equipped with older style arms (clips) as shown in

Dual-Control Mecha

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Figure 20C, it is extremely important that they be installed in the proper position. Ensure that the extended, raised portion of each arm, when repositioned on the No. 1 set of lock rods, faces the point detector end of the machine (raised portion of arm up).

Dual-Control Mechanism (Models 5F and 5H)

1. Remove nut and washers from the top of the operating crank's splined shaft.
2. Loosen, but do not remove, the nut from the idler-gear stud.
3. Remove the five dowel screws that hold the gear plate in place. Pry this plate up and off. The crank-shaft's top bearing and idler gear with stud will come off with the plate as a unit. Remove these from the gear plate.
4. Remove the selector shaft bearing which is on the opposite side of the machine from the hand-throw lever.
5. Remove the two screws that hold the selector and hand-throw lever assembly to the machine. Pull the assembly as a unit from the side of the machine.
6. Remove the throw-bar guards and coupling. Fasten the down-set throw-bar guard on the hand-throw side of the machine. Turn the gear and contact compartment cover hasp end for end.
7. Replace the selector and hand-throw lever assembly as a unit on the opposite side of the machine.
8. Remove the hand-throw lever extension handle from the end of the hand-throw lever. Replace the handle in the opposite tapped hole.
9. Replace the selector shaft bearing on the track side of the machine. Keep the lubrication fitting toward the contact compartment end of the machine.
10. To start the timing operation of the dual-control mechanism, place the selector lever in the POWER position. Crank the machine in the direction which will bring the throw-bar coupling nearest the machine. After the full stroke in this direction is completed, make a mark across the throw-bar against the edge of the gear frame. Crank the machine until the full throw-bar stroke is completed in the opposite direction. Measure midway between the mark on the throw-bar and the edge of the gear frame, and make a mark on the throw-bar at this point. Crank the machine back until this latter mark is just at the edge of the gear frame. This positions the throw-bar and crank exactly in the midstroke position.
11. Place the selector lever in the HAND position. Rotate hand-throw clutch gear A, Figure 5, by hand counterclockwise until it stops. With a pointer resting on the edge of the gear frame, slowly rotate the hand-throw clutch gear clockwise counting the number of teeth it rotates. Now, rotate it back just half as many teeth. Mark the tooth now nearest the centerline of the gear frame and also place a corresponding mark on the gear frame.
12. Place and hold the hand-throw lever in a vertical position (90 degrees to the base of the machine).
13. Hold the hand-throw clutch gear firmly in alignment with the marks just put on it and adjacent frame. Hold idler gear B, Figure 5, suspended by its stud, and mesh it with the hand-throw clutch gear so that the letters R are in line for right-hand assembly or letters L are in line for left-hand assembly. Now, let the idler gear down until it meshes freely with the hand-throw pinion and the outside of its spur gear teeth follows closely the contour of the adjacent gear frame.
14. Set the gear plate in position on the machine. Be sure that the small pin on the side of the idler gear stud lines up with the groove in the hole in the gear plate.
15. Insert the five dowel screws in the gear plate, finger-tight. Assemble the nut and lock washer on the idler gear stud and the roller bearing, washers, and nut on the top of the crankshaft. Tighten the five dowel screws that hold the gear plate in place.
16. Check the timing between the hand-throw clutch gear, the idler gear, and the hand-throw pinion, using any of the methods outlined under "Timing Test Procedure".
17. Replace the throw-bar guard on the track side of the machine. Tighten all screws and nuts. Bend the washer up (preferably at a new place) to lock the nut on the top of the operating crankshaft.

NOTE: If the operating crank has been removed, or if the clutch sleeve has been removed from the operating crank's splined shaft, be sure when they are reassembled that the prick-punch mark on the clutch sleeve's uppermost raised cam surface is aligned with the centerline of the op-

erating crank. If the gear frame is assembled on the base, and the crank is therefore not visible, align the prick-punch mark with the one located on the top of the crank's splined shaft. This ensures that the splines on the shaft and inside the sleeve are in proper engagement.

TIMING TEST PROCEDURES *

Displacement of Upper Crank Bearing Washer

1. Remove the gear compartment cover. The upper crank bearing washer, in the center of the top bearing bracket plate, Figure 21, is marked with an arrow.
2. Set the selector lever to the hand-throw position.
3. Slowly move the hand-throw lever first to the normal position, then to the reverse position to cause the arrow to be displaced first on one side of the center, then on the other. If the timing is correct, the displacement will be equal on each side of the center line.

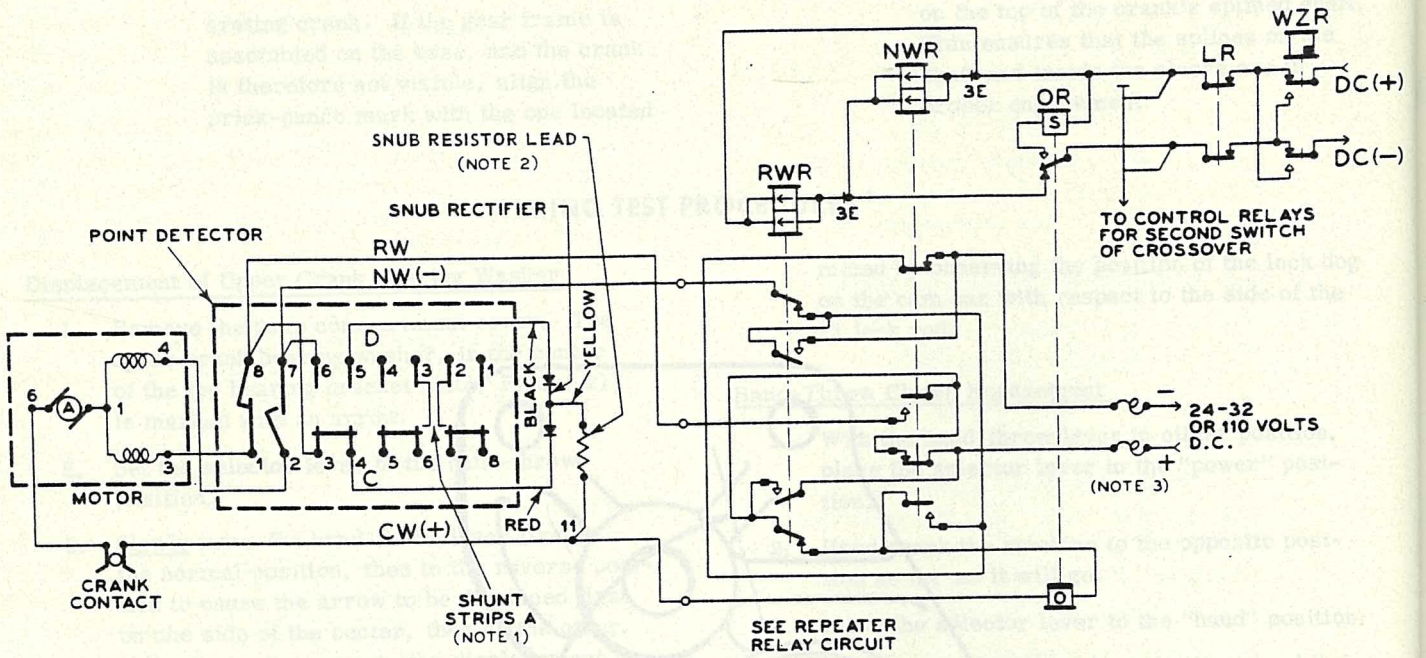
Displacement of Cam Bar C, Figure 5

1. Remove the contact compartment cover. The cam bar is in the bottom of the case, centered along the center line of the machine and between the gear movement and the point detector movement. It can be seen between the biased neutral controller and the point detector movement.
2. Hand-operate the machine slowly first one way, then the other to move the cam bar toward the point detector movement and back again (a full stroke for each operation of the machine). If the timing is correct, the cam bar will return to very near the same position each time the hand-throw lever is operated. This is determined by observing the position of the lock dog on the cam bar with respect to the side of the #1 lock rod.

Hand-Throw Clutch Engagement

1. With the hand-throw lever in either position, place the selector lever in the "power" position.
2. Hand crank the machine to the opposite position as far as it will go.
3. Move the selector lever to the "hand" position.
4. Move the hand-throw lever slowly toward the position to which the machine was cranked in step 2.
5. Observe the hand-throw clutch gear and clutch sleeve. As the hand-throw lever nears the horizontal position in the direction to which the machine was cranked, the clutch sleeve should slip into engagement with the hand-throw clutch gear. Note how far above the horizontal this happens.
6. Repeat the whole procedure, cranking the machine in the opposite direction. The hand-throw clutch gear should engage at approximately the same angle above horizontal for each direction, if the timing is correct.

***The dual control switch machine must be properly timed. If timing is incorrect there is risk of derailment after the machine has been thrown by the hand-throw lever and before it has been thrown by power.**

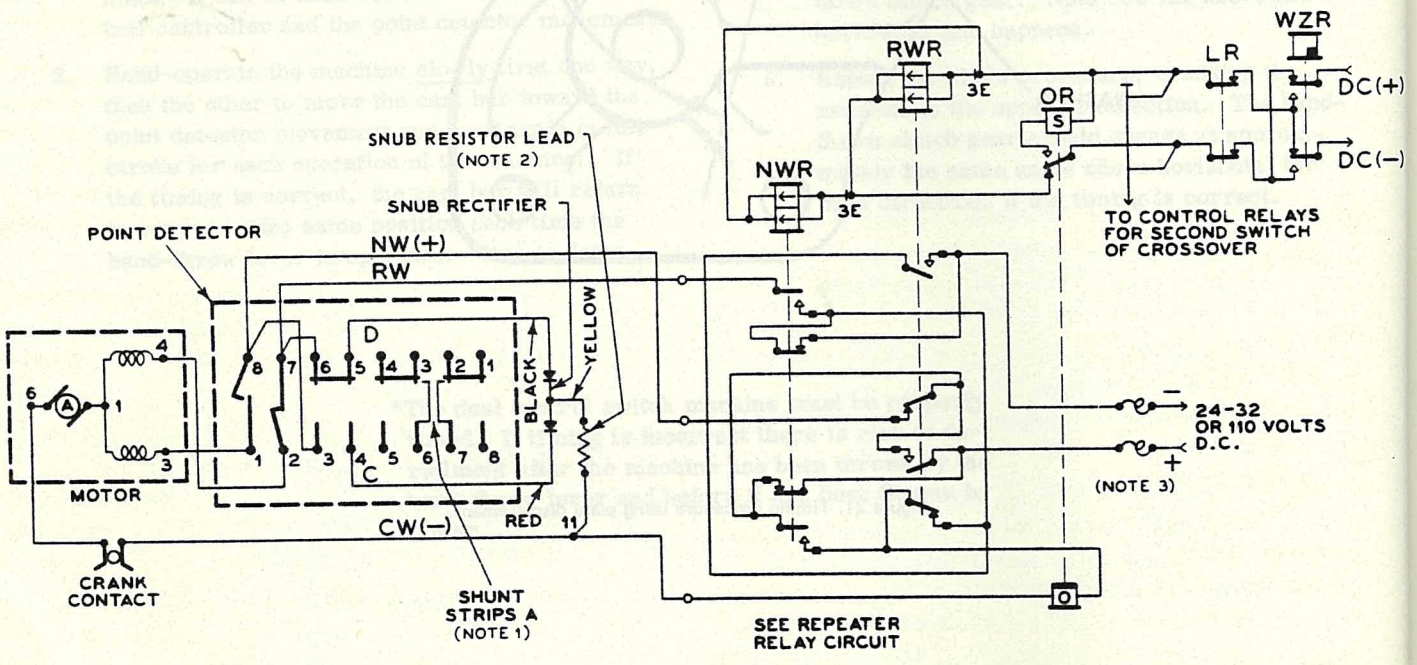


NOTE 1. Shunt strips A are used for polarized switch repeater relay circuits only.

NOTE 2. Snub resistor lead is used in 110-volt machines only.

NOTE 3. 8-amp Fusetrons are used with 110-volt machines.
10-amp Fusetrons are used with 24- to 32-bolt machines.

Figure 22. Typical Model 5E wiring diagram and control circuit, right-hand point normally closed.

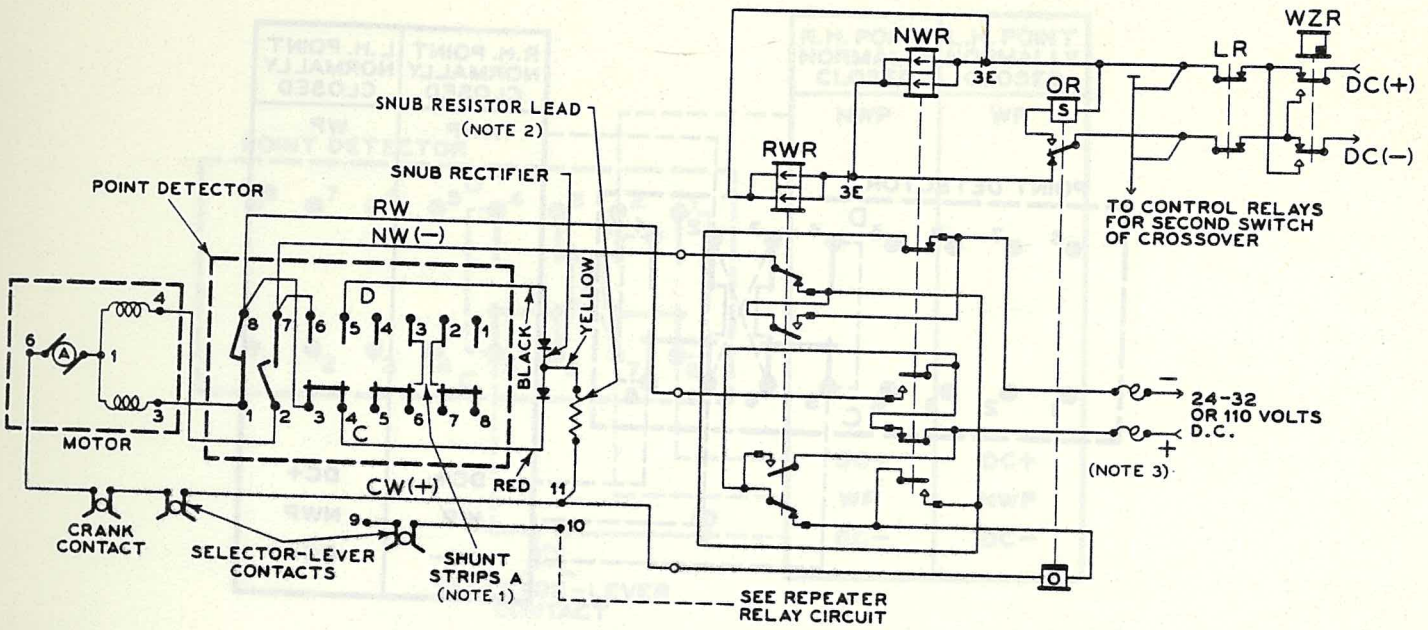


NOTE 1. Shunt strips A are used for polarized switch repeater relay circuits only.

NOTE 2. Snub resistor lead is used in 110-volt machines only.

NOTE 3. 8-amp Fusetrons are used with 110-volt machines.
10-amp Fusetrons are used with 24- to 32-volt machines.

Figure 23. Typical Model 5E wiring diagram and control circuit, left-hand point normally closed.

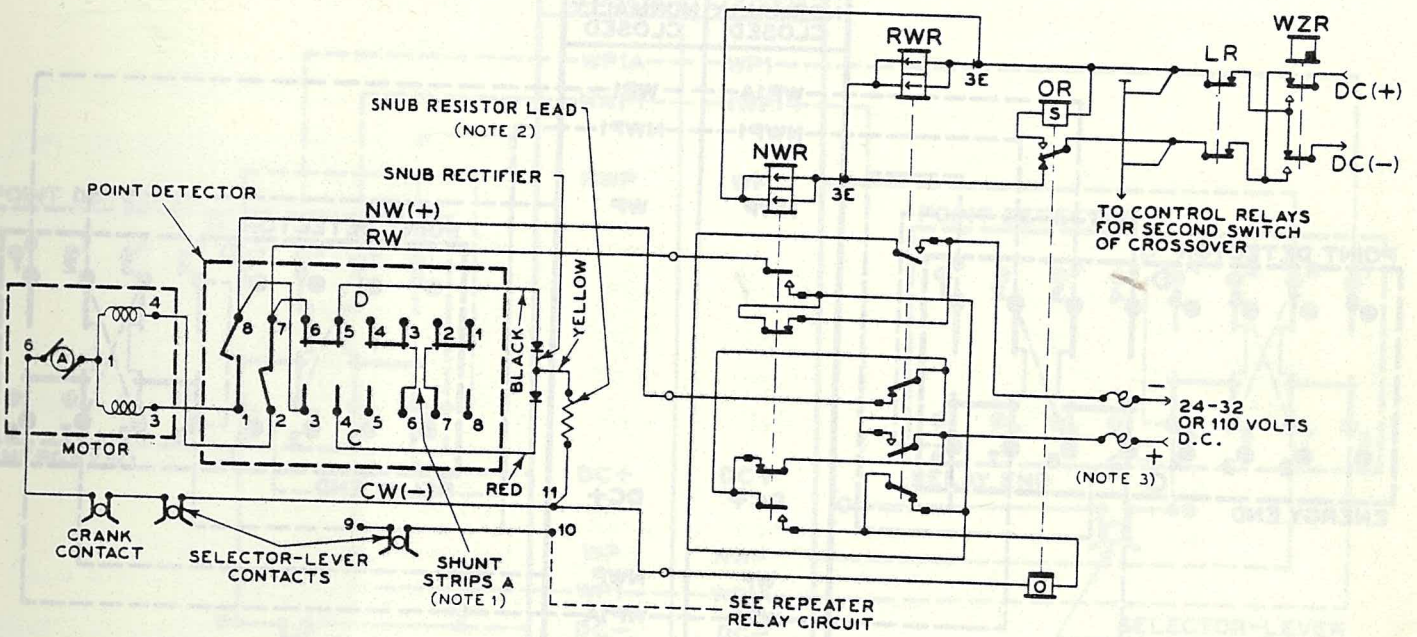


NOTE 1. Shunt strips A are used for polarized switch repeater relay circuits only.

NOTE 2. Snub resistor lead is used in 110-volt machines only.

NOTE 3. 8-amp Fusetrons are used with 110-volt machines.
10-amp Fusetrons are used with 24- to 32-volt machines.

Figure 24. Typical Model 5F wiring diagram and control circuit, right-hand point normally closed.

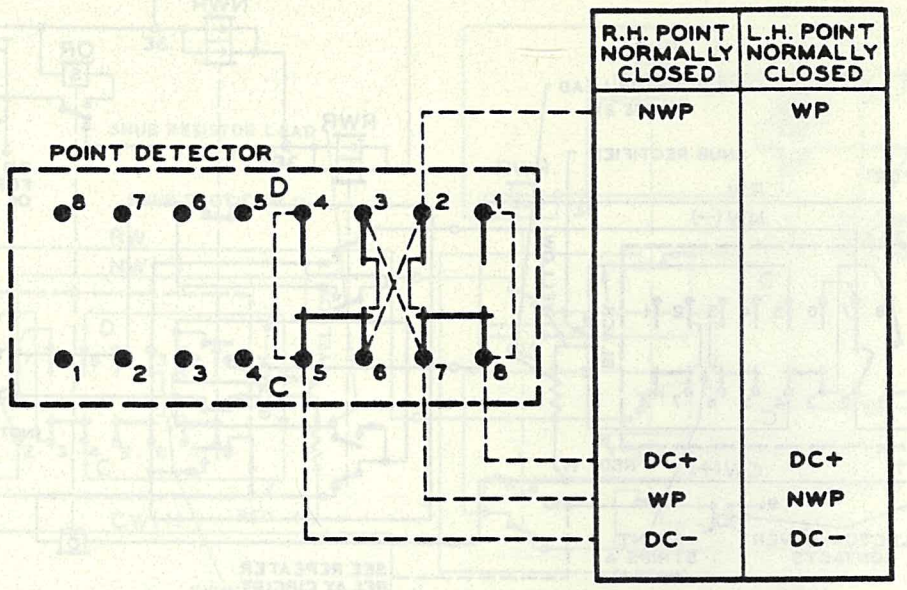


NOTE 1. Shunt strips A are used for polarized switch repeater relay circuits only.

NOTE 2. Snub resistor lead is used in 110-volt machines only.

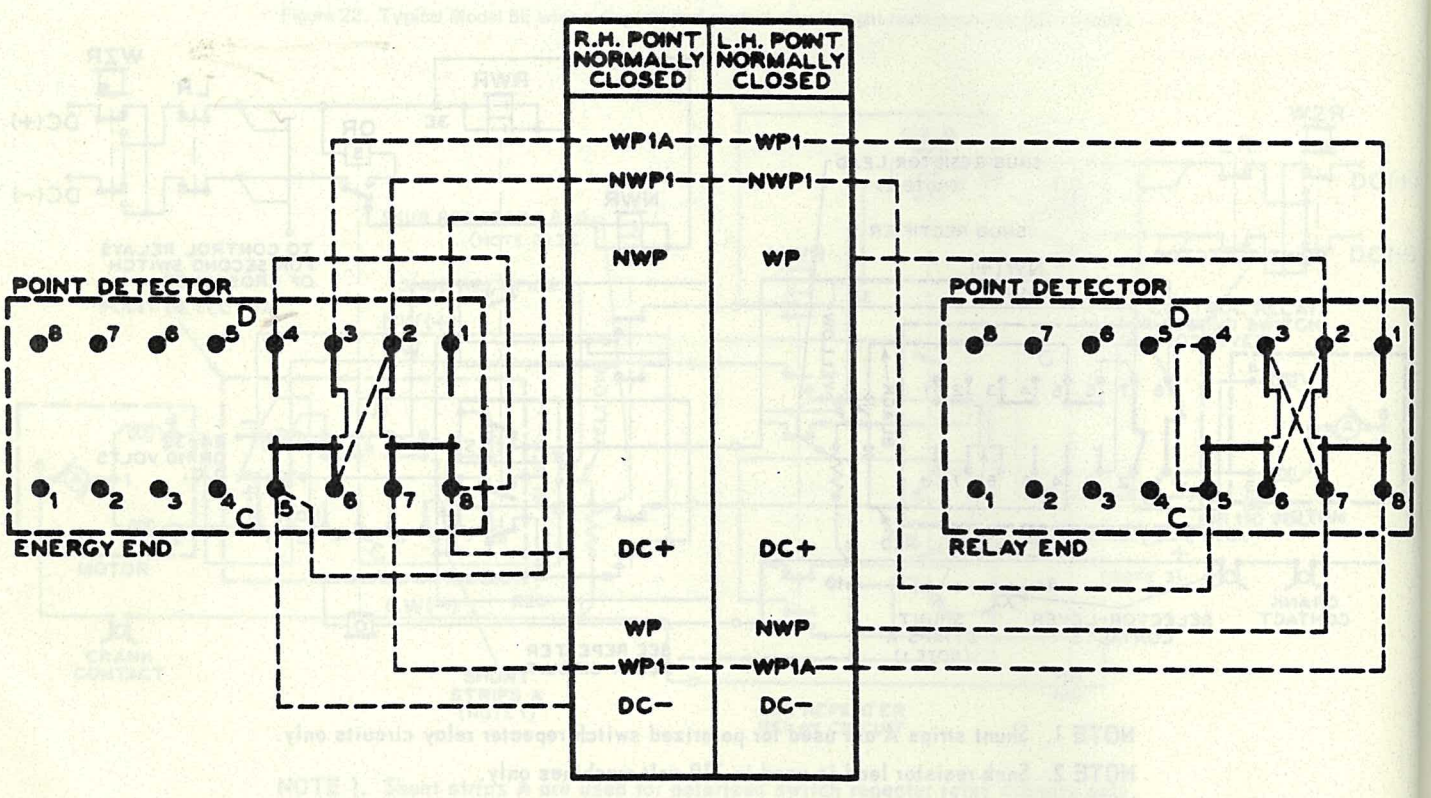
NOTE 3. 8-amp Fusetrons are used with 110-volt machines.
10-amp Fusetrons are used with 24- to 32-volt machines.

Figure 25. Typical Model 5F wiring diagram and control circuit, left-hand point normally closed.



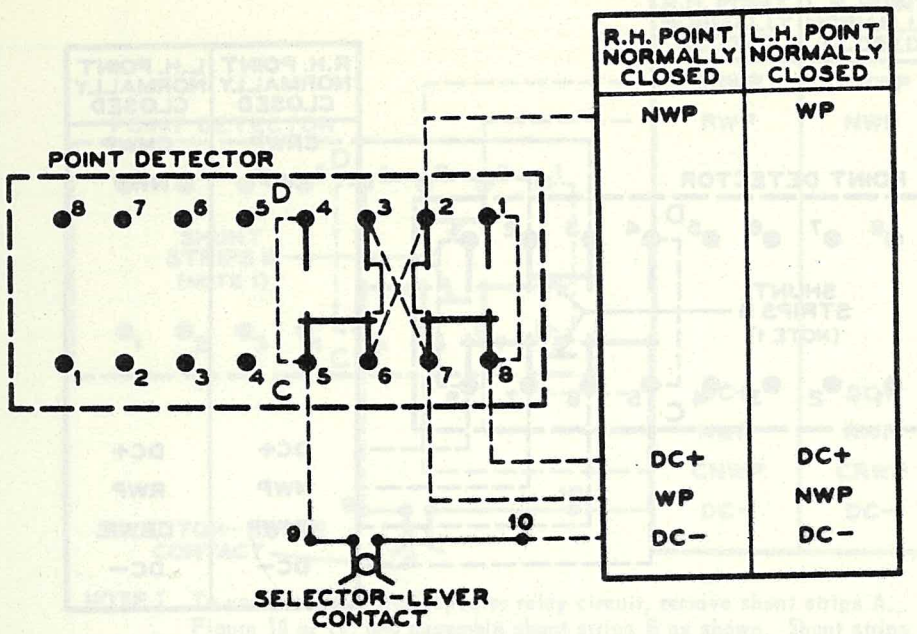
NOTE: Point-detector contacts are shown in position for right-hand point normally closed.

Figure 26. Typical polarized switch repeater relay circuit using shunt strips A, single switch. Model 5E switch machine.



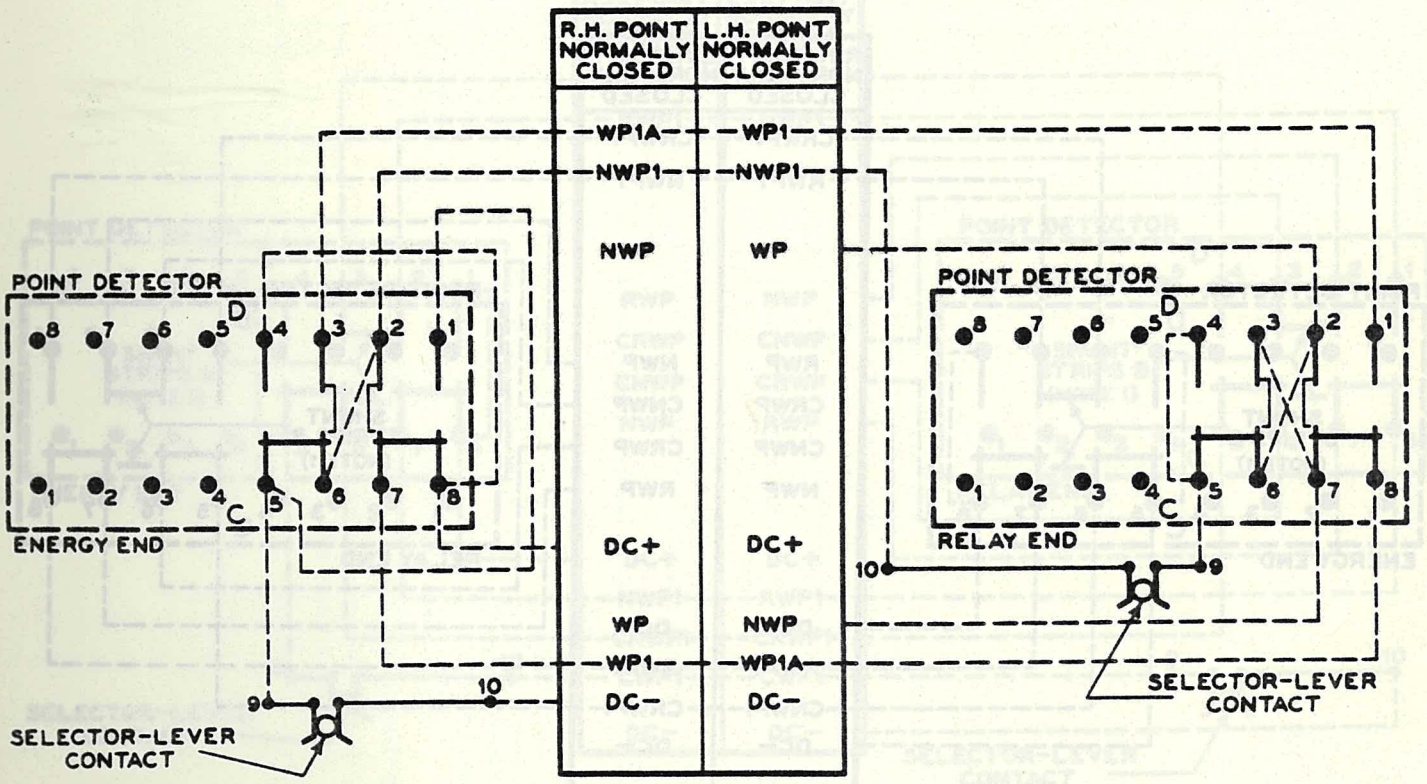
NOTE: Point-detector contacts are shown in position for right-hand point normally closed.

Figure 27. Typical polarized switch repeater relay circuit using shunt strips A, crossover. Two Model 5E switch machines.



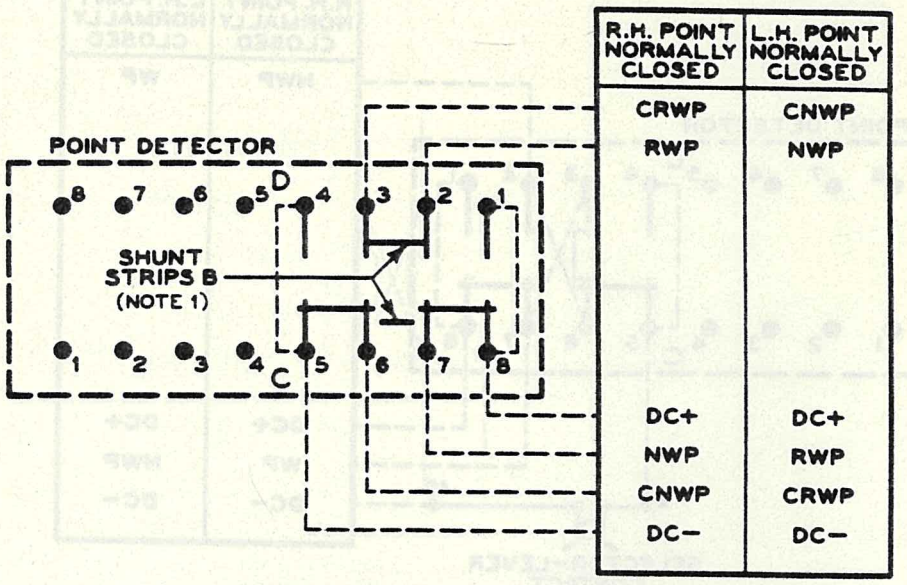
NOTE: Point-detector contacts are shown in position for right-hand point normally closed.

Figure 28. Typical polarized switch repeater relay circuit using shunt strips A, single switch. Model 5F switch machine.



NOTE: Point-detector contacts are shown in position for right-hand point normally closed.

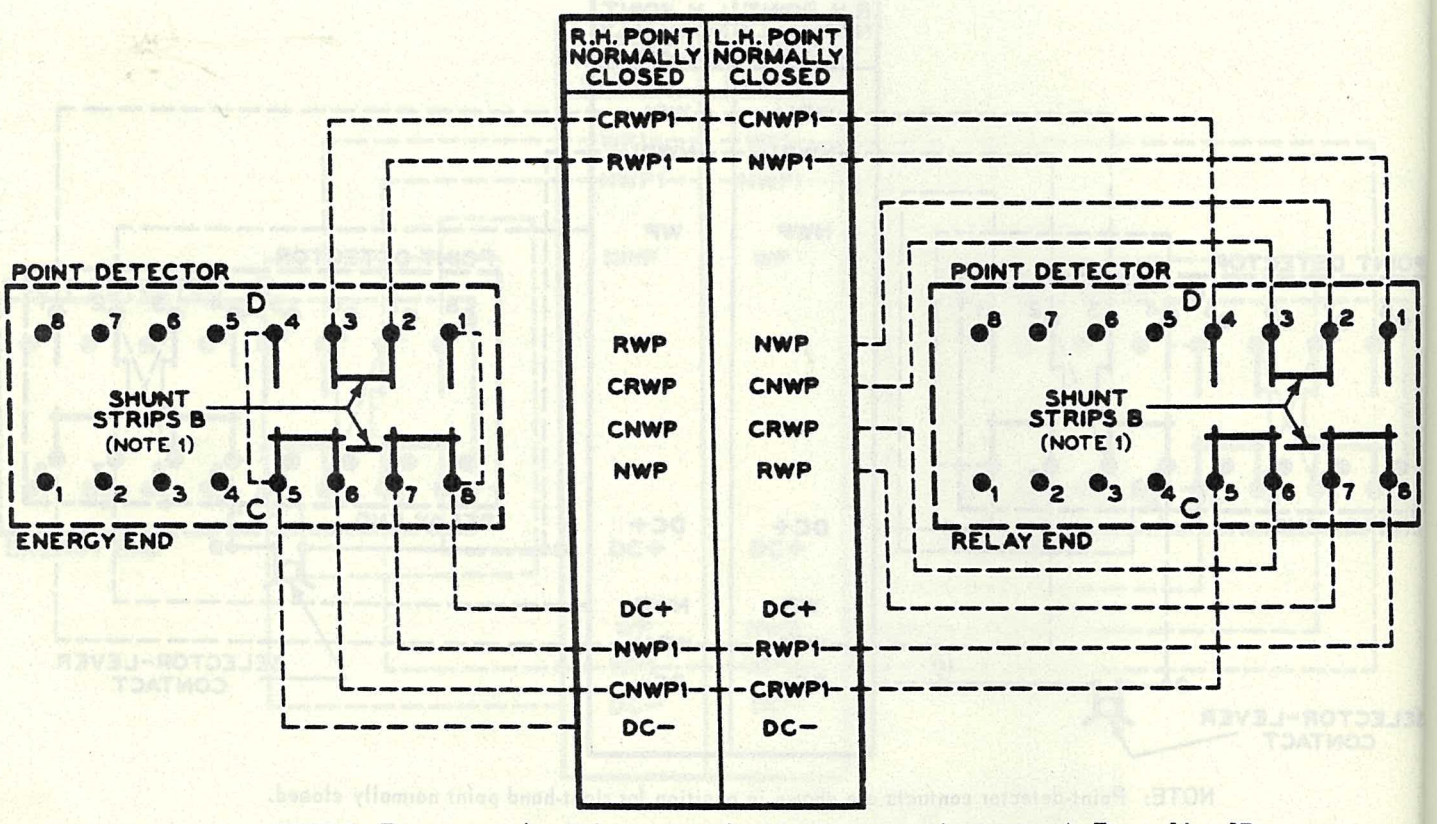
Figure 29. Typical polarized switch repeater relay circuit using shunt strips A, crossover. Two Model 5F switch machines.



NOTE 1. To use neutral switch repeater relay circuit, remove shunt strips A, Figure 16 or 17, and assemble shunt strips B as shown. Shunt strips B are in the cloth bag which contains the motor ventilators.

NOTE 2. Point-detector contacts are shown in position for right-hand point normally closed.

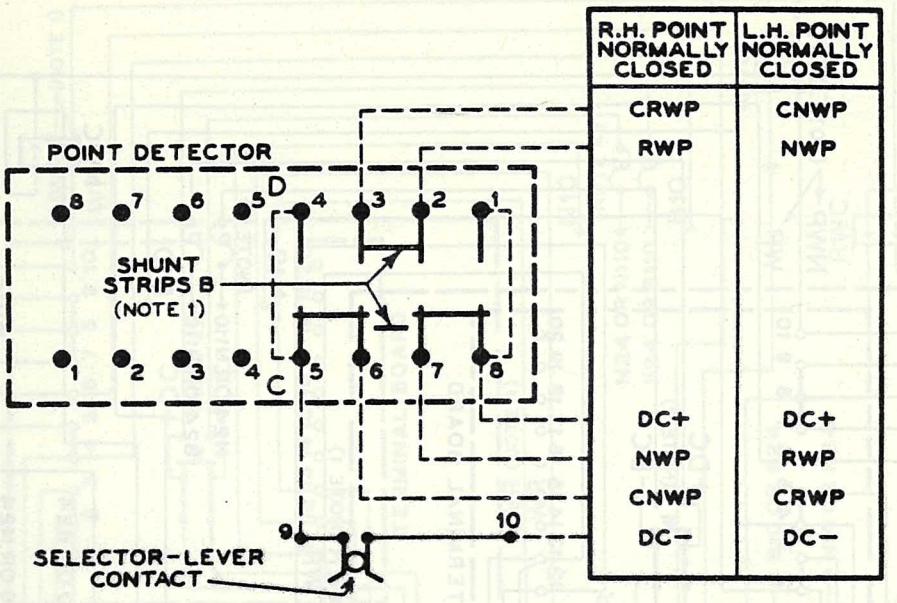
Figure 30. Typical neutral switch repeater relay circuit, single switch. Model 5E switch machine.



NOTE 1. To use neutral switch repeater relay circuit, remove shunt strips A, Figure 16 or 17, and assemble shunt strips B as shown. Shunt strips B are in the cloth bag which contains the motor ventilators.

NOTE 2. Point-detector contacts are shown in position for right-hand point normally closed.

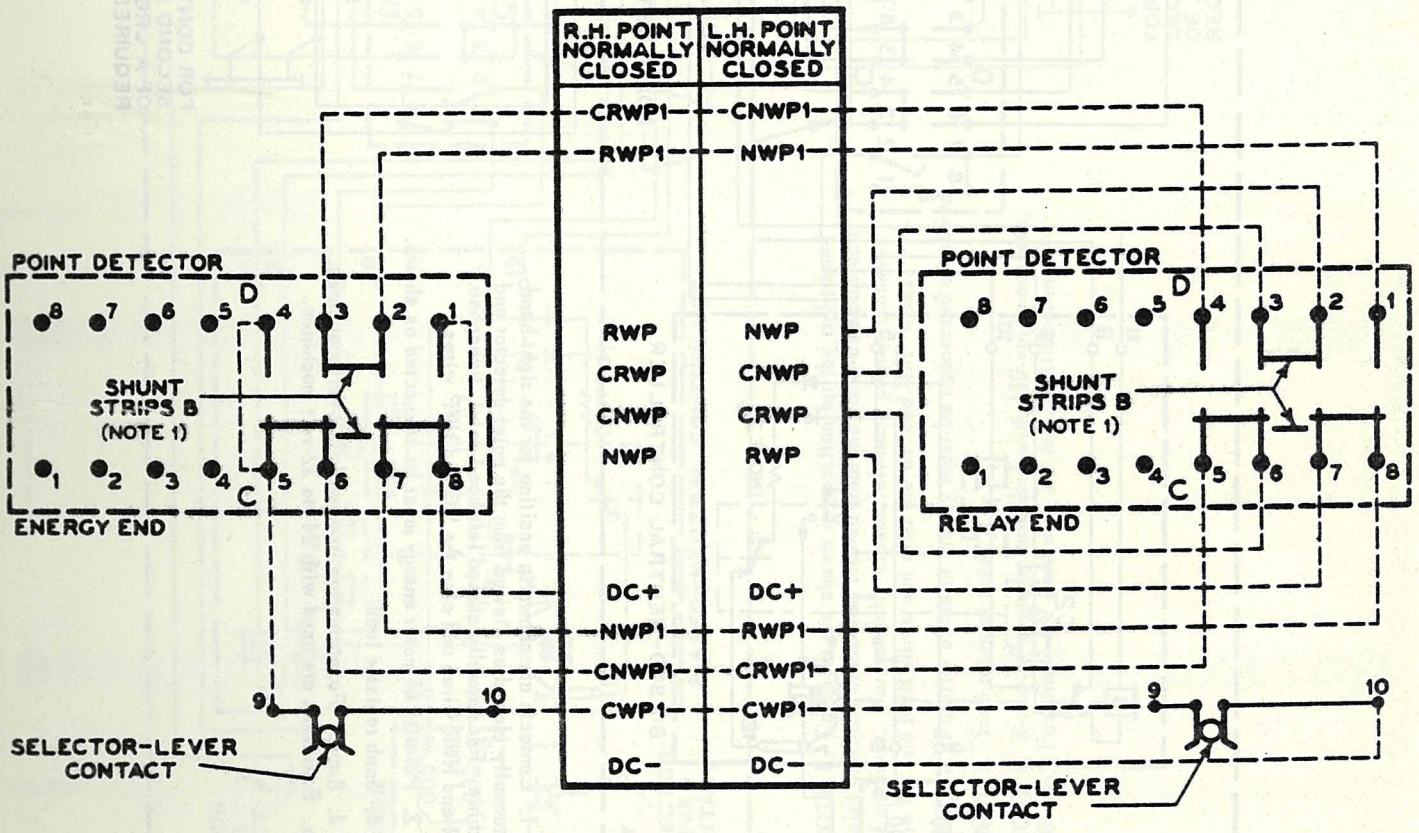
Figure 31. Typical neutral switch repeater relay circuit, crossover. Two Model 5E switch machines.



NOTE 1. To use neutral switch repeater relay circuit, remove shunt strips A, Figure 18 or 19, and assemble shunt strips B as shown. Shunt strips B are in the cloth bag which contains the motor ventilators.

NOTE 2. Point-detector contacts are shown in position for right-hand point normally closed.

Figure 32. Typical neutral switch repeater relay circuit, single switch. Model 5F switch machine.



NOTE 1. To use neutral switch repeater relay circuit, remove shunt strips A, Figure 18 or 19, and assemble shunt strips B as shown. Shunt strips B are in the cloth bag which contains the motor ventilators.

NOTE 2. Point-detector contacts are shown in position for right-hand point normally closed.

Figure 33. Typical switch repeater relay circuit, crossover. Two Model 5F switch machines.

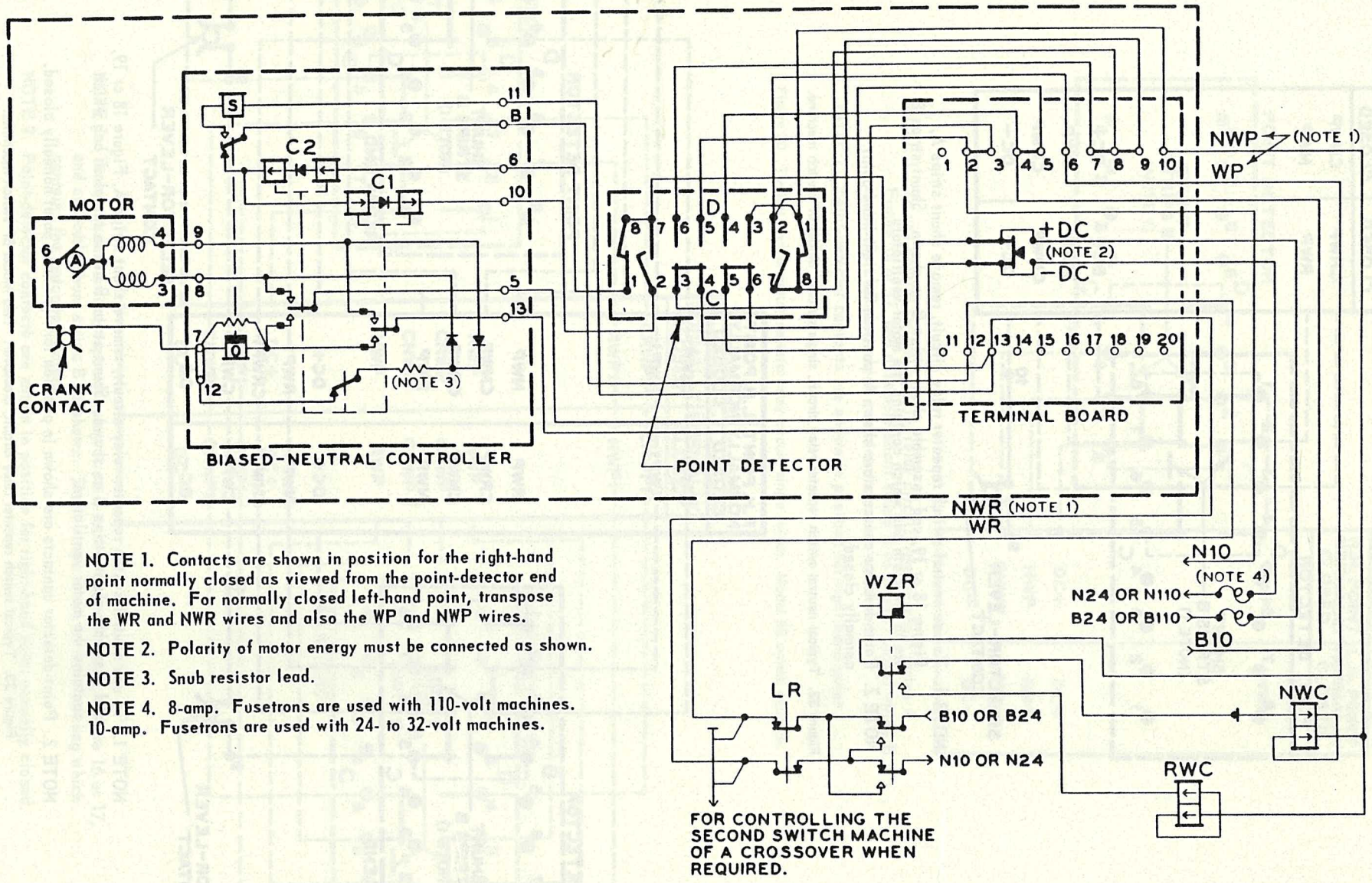


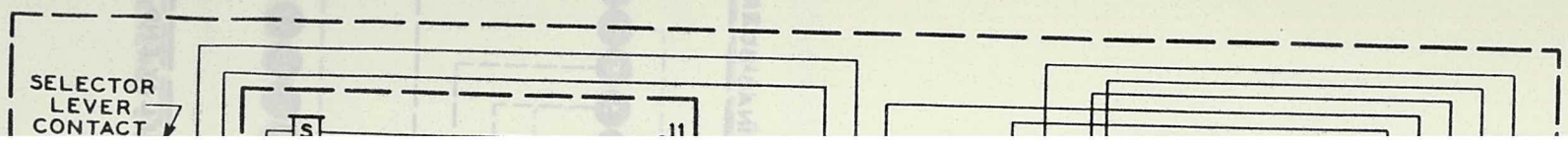
Figure 34. Typical Model 5G wiring diagram and control circuit, right-hand point normally closed.

NOTE 1. Contacts are shown in position for the right-hand point normally closed as viewed from the point-detector end of machine. For normally closed left-hand point, transpose the WR and NWR wires and also the WP and NWP wires.

NOTE 2. Polarity of motor energy must be connected as shown.

NOTE 3. Snub resistor lead.

NOTE 4. 8-amp. Fusetrons are used with 110-volt machines. 10-amp. Fusetrons are used with 24- to 32-volt machines.



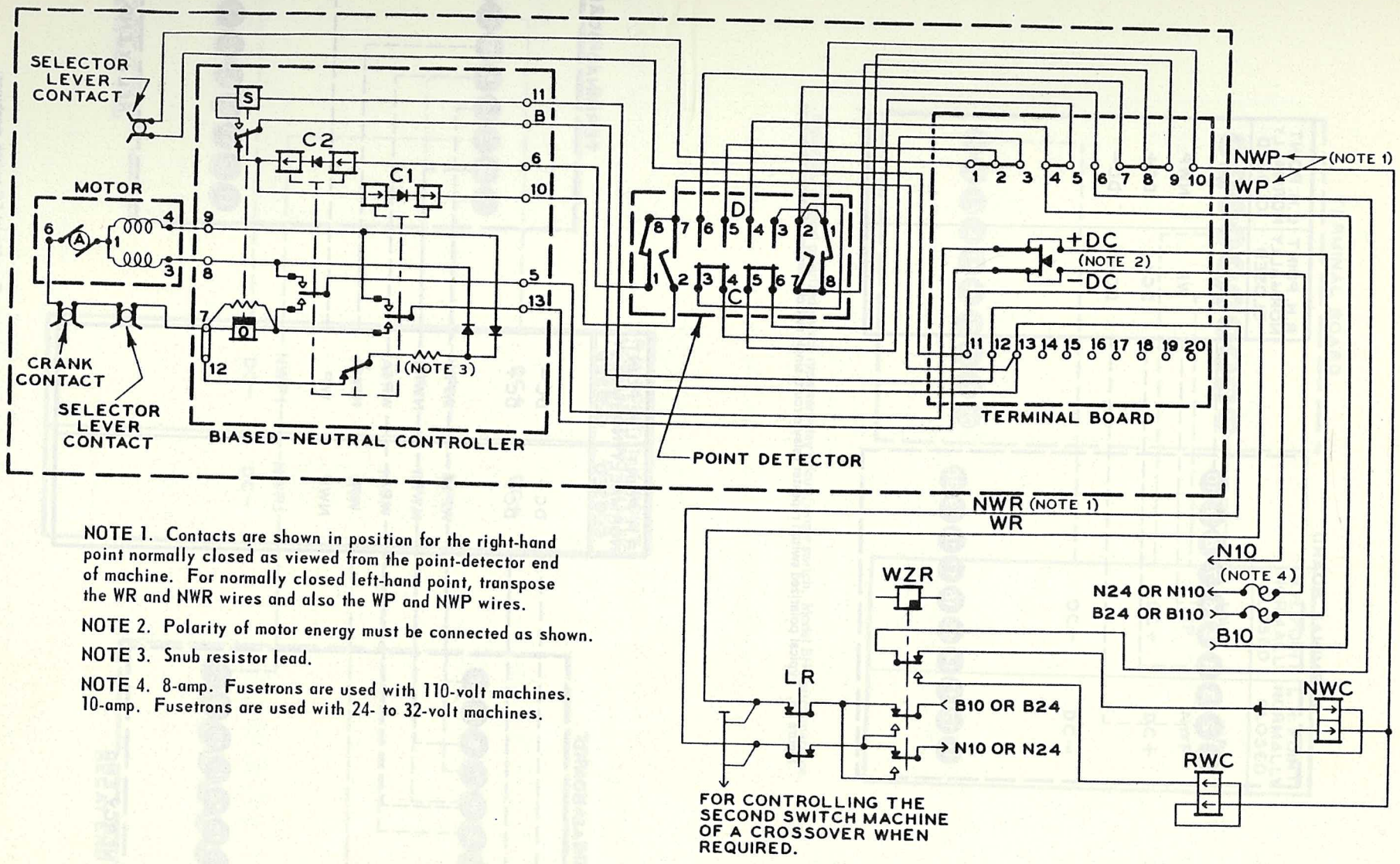


Figure 35. Typical Model 5H wiring diagram and control circuit, right-hand point normally closed.

NOTE 1. Contacts are shown in position for the right-hand point normally closed as viewed from the point-detector end of machine. For normally closed left-hand point, transpose the WR and NWR wires and also the WP and NWP wires.

NOTE 2. Polarity of motor energy must be connected as shown.

NOTE 3. Snub resistor lead.

NOTE 4. 8-amp. Fusetrons are used with 110-volt machines. 10-amp. Fusetrons are used with 24- to 32-volt machines.

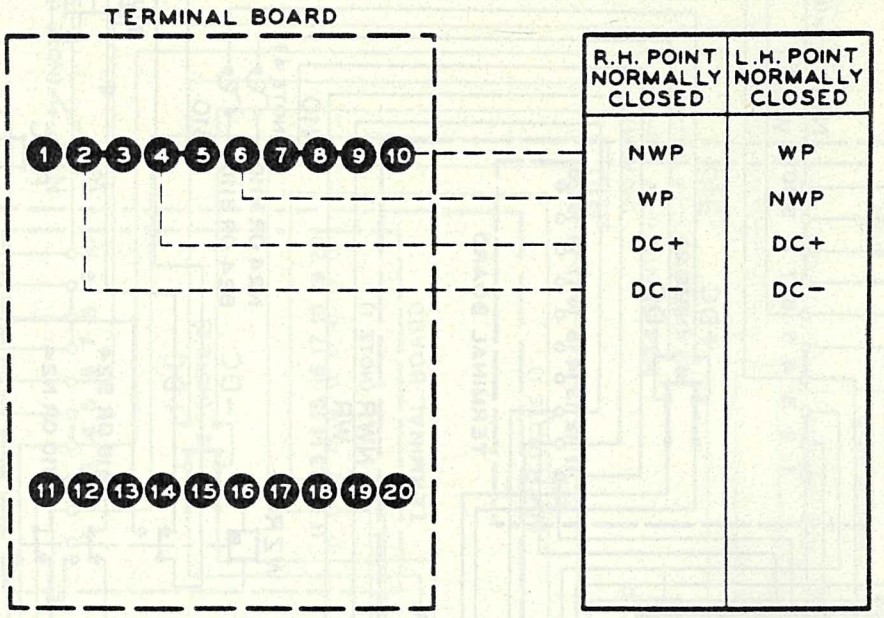


Figure 36. Typical polarized switch repeater relay circuit, single switch. Model 5G switch machine.

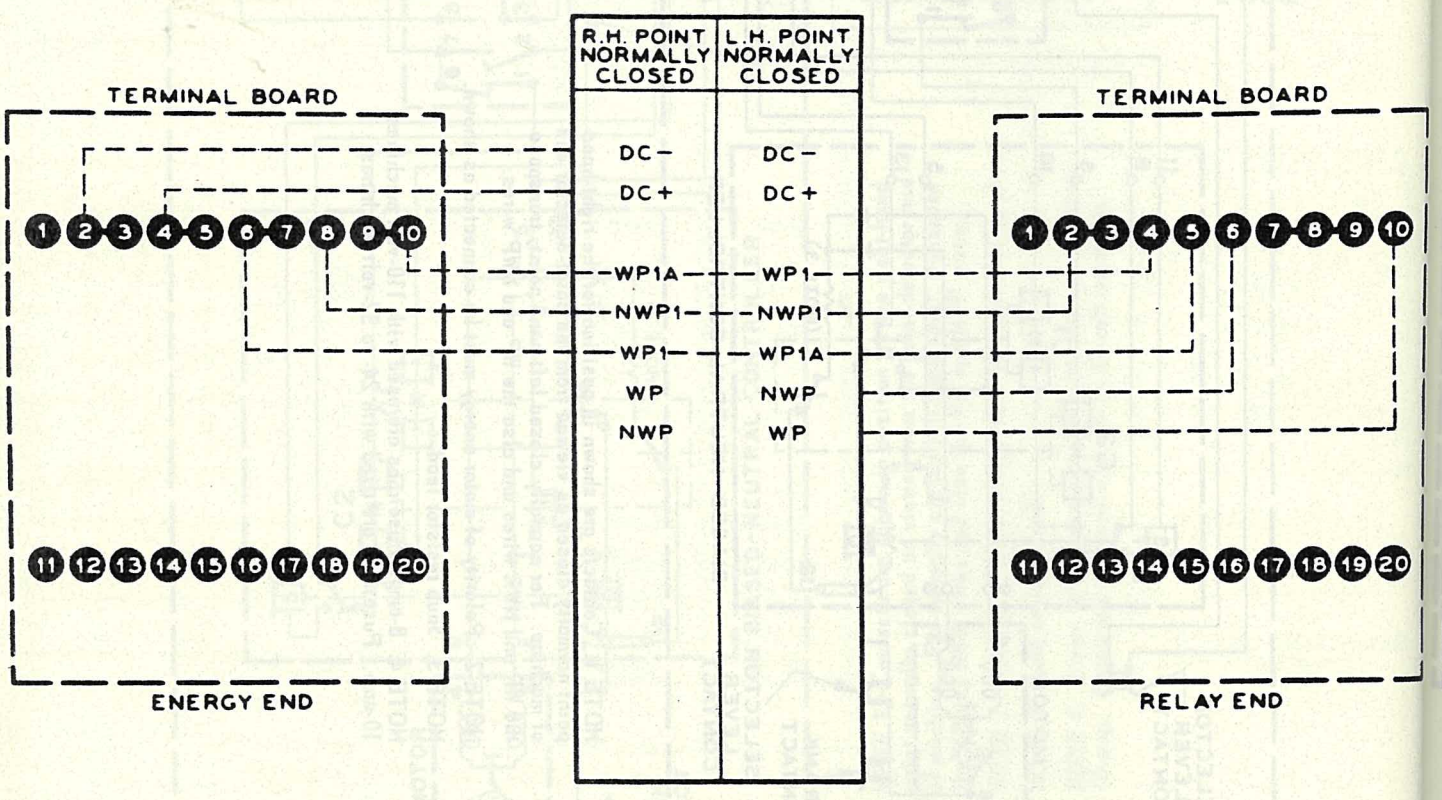


Figure 37. Typical polarized switch repeater relay circuit, crossover. Two Model 5G switch machines.

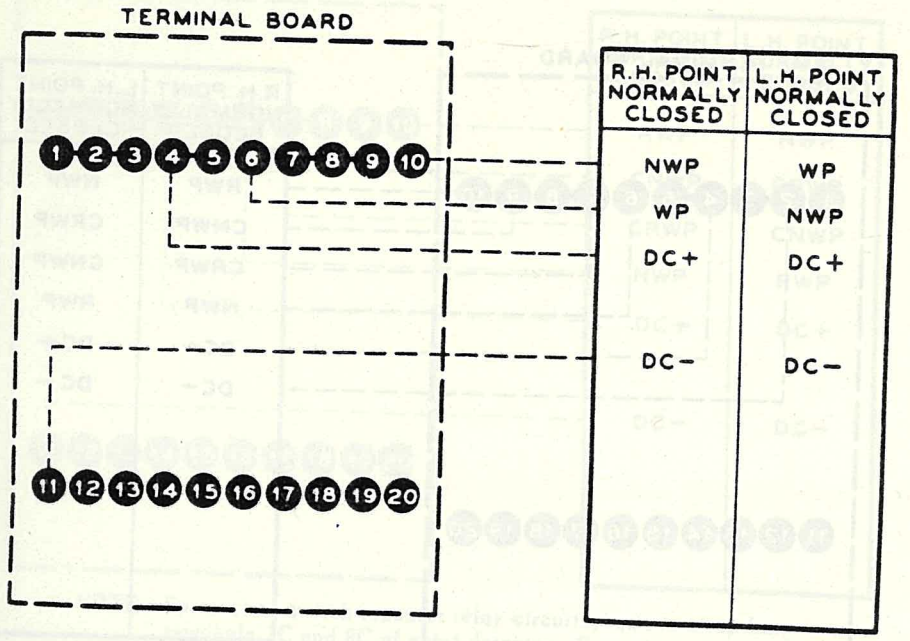


Figure 38. Typical polarized switch repeater relay circuit, single switch. Model 5H switch machine.

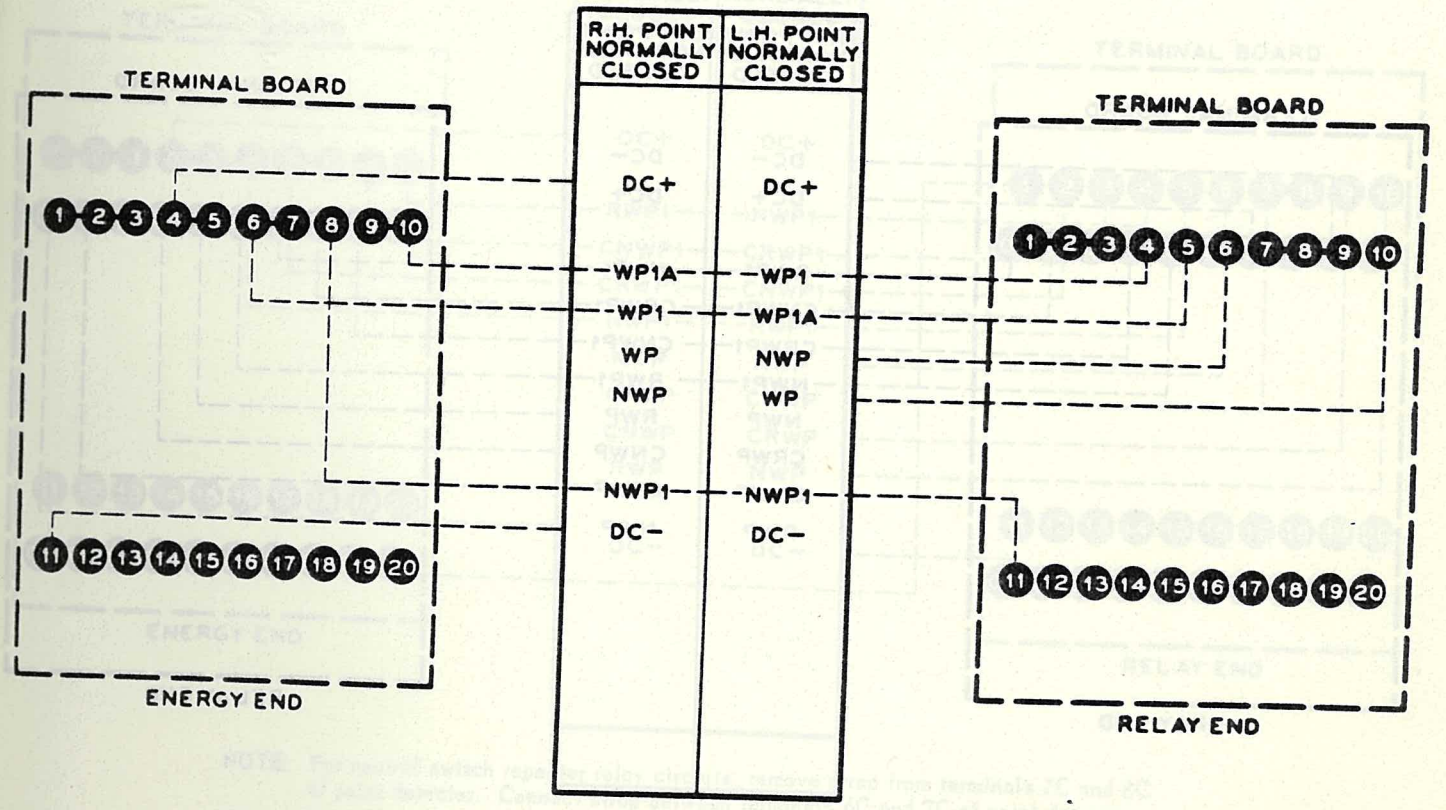
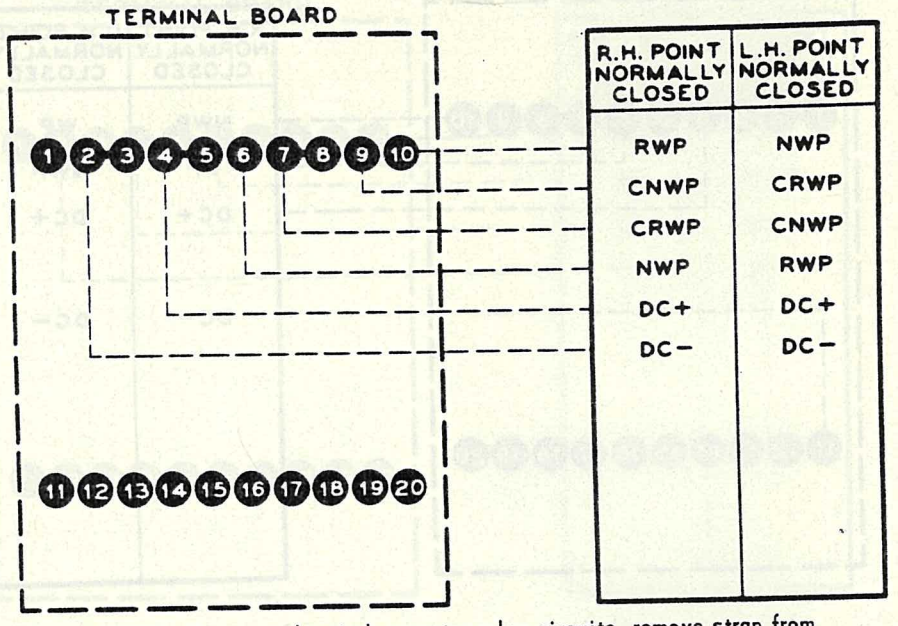
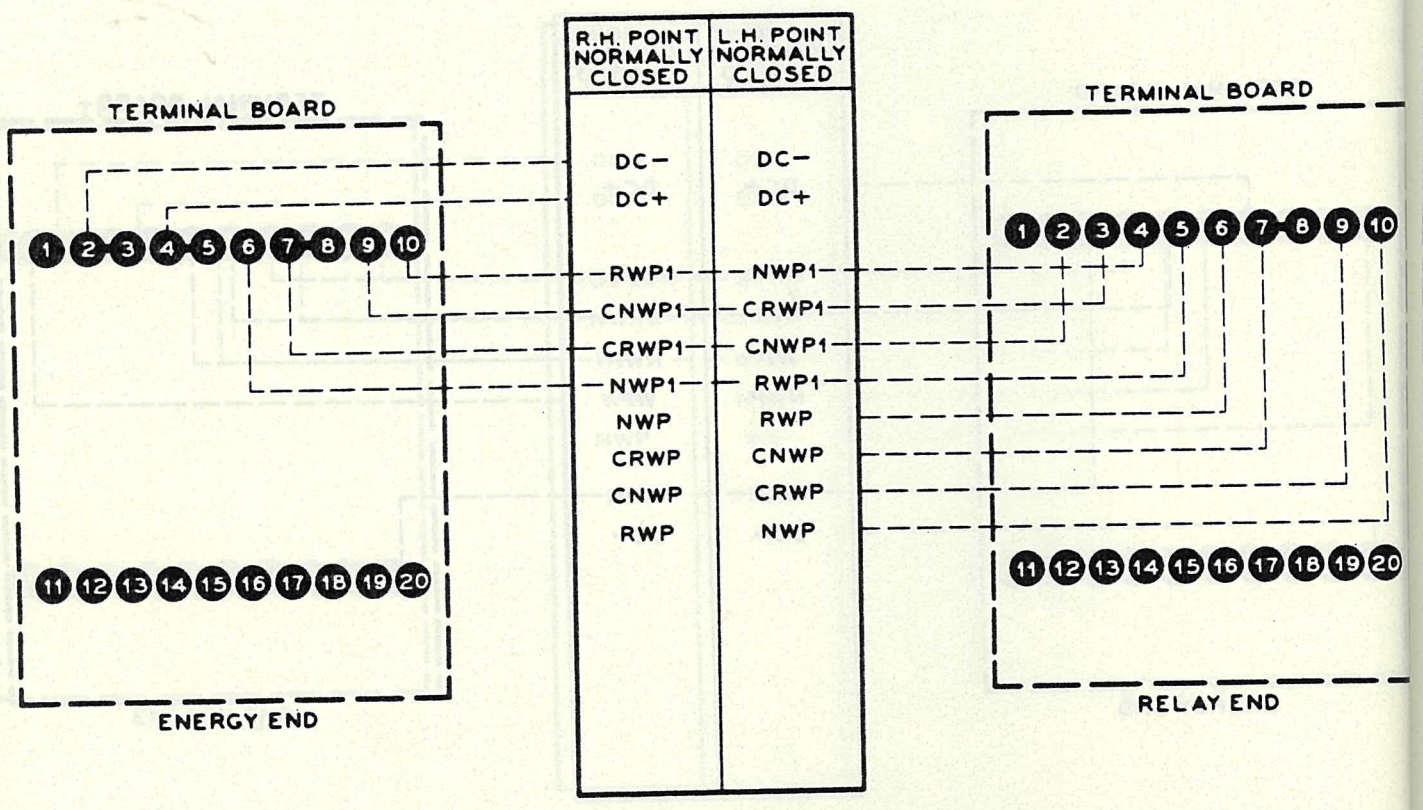


Figure 39. Typical polarized switch repeater relay circuit, crossover. Two Model 5H switch machines.



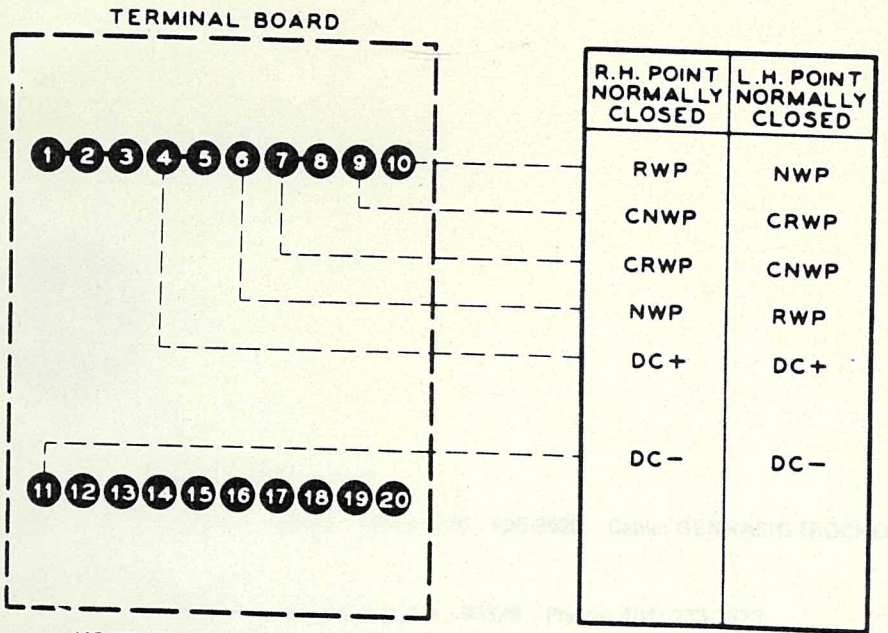
NOTE: For neutral switch repeater relay circuits, remove strap from terminals 7C and 8C of point detector. Connect strap between terminals 6C and 7C of point detector.

Figure 40. Typical neutral switch repeater relay circuit, single switch. Model 5G switch machine.



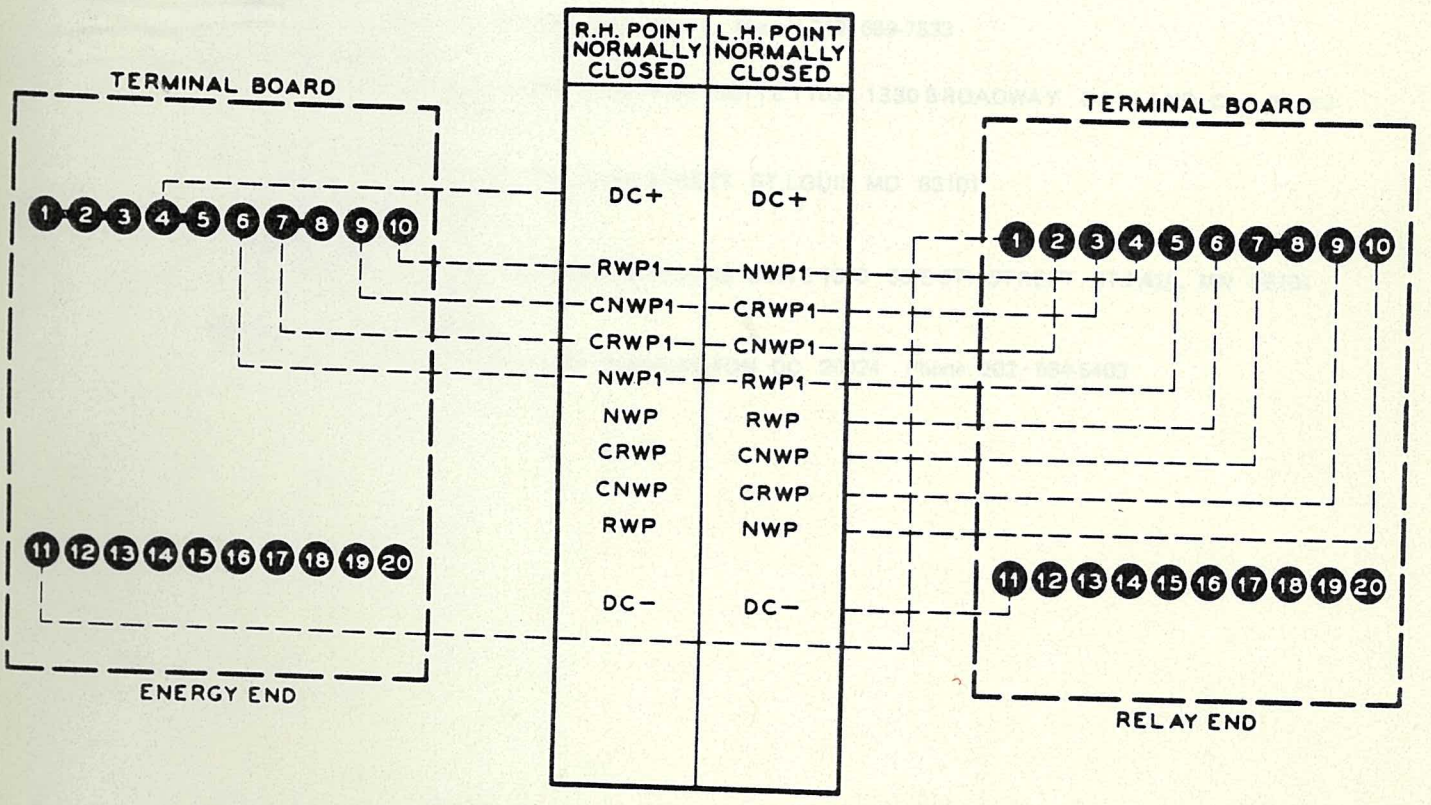
NOTE: For neutral switch repeater relay circuits, remove strap from terminals 7C and 8C of point detector. Connect strap between terminals 6C and 7C of point detector.

Figure 41. Typical neutral switch repeater relay circuit, crossover. Two Model 5G switch machines.



NOTE: For neutral switch repeater relay circuits, remove strap from terminals 7C and 8C of point detector. Connect strap between terminals 6C and 7C of point detector.

Figure 42. Typical neutral switch repeater relay circuit, single switch. Model 5H switch machine.



NOTE: For neutral switch repeater relay circuits, remove strap from terminals 7C and 8C of point detector. Connect strap between terminals 6C and 7C of point detector.

Figure 43. Typical neutral switch repeater relay circuit, crossover. Two Model 5H switch machines.

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GENERAL RAILWAY SIGNAL COMPANY
A UNIT OF GENERAL SIGNAL

6-74

PAMPHLET 1217
MARCH 1965

GRS MODEL 55 ELECTRIC SWITCH MACHINE

INSTALLATION, ADJUSTMENT AND MAINTENANCE

A UNIT OF GENERAL SIGNAL CORPORATION

GENERAL RAILWAY SIGNAL COMPANY

ROCHESTER, N.Y. 14602

CONTENTS

	Page
INTRODUCTION	3
DESCRIPTION	3
INSTALLATION AND ADJUSTMENT	4
Right- or Left-Hand Layout	4
Mounting	5
Wiring	5
Throw Rod - To Connect and Adjust	5
Point-Detector Rod - To Connect and Adjust	5
Lock Rod - To Connect and Adjust	6
MAINTENANCE	6
Lubrication	7
Holding Device - Annual Inspection	7
Motor	7
Cranking	8
Overload Friction Clutch	8
Point Detector	8
Wear Plates	9
OPTIONAL EQUIPMENT	10
Biased-Neutral Controller	10

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INTRODUCTION

The GRS Model 55 electric switch machine incorporates all of the features required to meet interlocking practices. It can be used in mainline or rapid transit service to operate either a single switch, a double-slip switch with a continuous front rod, or any type derail, regardless of variations in switch fitting standards and weight of rail. It is interchangeable - both in mounting arrangements and wiring connections - with the GRS Models 5C, 5E, and 5G switch machines. With a minimum change in layout, it is interchangeable with the GRS Model 5 machine used in rapid transit applications.

DESCRIPTION

The Model 55 switch machine is designed for power operation only - from either a 24- or 110-volt d-c supply, or any suitable rectified a-c supply. Operating time for the low voltage machine is approximately 9 seconds; for the high-voltage machine, approximately 3 seconds.

It can be controlled either directly from externally housed relays or with an optional, built-in, biased-neutral controller. The control energy (10- to 12- or 24- to 32-volts d-c) can be applied to the controller either through relays located near the switch, or directly through the switch control lever.

A removable hand crank is provided for maintenance purposes and emergency use. The Model 55 is equipped with a manually-operated crank cutout contact.

Unit construction of major assemblies - motor, intermediate gear train (including the overload clutch), main gear, point detector, and optional biased neutral controller - facilitates inspection or replacement. Practically all internal parts are readily accessible when the one-piece, deep-sided, aluminum cover is removed.

The compact motor, only 4 inches in diameter, has encapsulated field coils and armature for maximum protection against moisture.

A simple holding device, consisting of a permanent ring magnet fixed in the motor housing cover and a similar magnet attached to the armature shaft, magnetically locks the motor armature when at rest.

With energy removed from the motor, the poles of the armature magnet align with the poles of opposite polarity in the fixed magnet. The magnetic-flux linkage between the magnetic poles (a magnetic detent effect) prevents armature rotation. When energy is applied to the motor, the armature torque overcomes the magnetic holding force, and the armature magnet rotates parallel to the fixed magnet.

To hand crank the machine, it is necessary to overcome the initial holding force of the holding device. Once started, hand cranking continues easily. At any point in the cranking, full holding effect returns whenever cranking stops or slows down sufficiently to permit the magnetic-flux linkage to overcome the cranking torque.

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The dry-plate overload clutch in the gear train absorbs any shock encountered in switch operation. The clutch is factory adjusted to slip when the motor operating current reaches 9 amperes for the 110-volt machine and 12 amperes for the 24-volt machine. Clutch adjustment can be changed in the field to suit railroad requirements.

The point-detector, an over-and-locked type of circuit controller, consists of two normal, two reverse, and two motor-control contacts. The normal and reverse contacts check and indicate when the switch points are within the proper distance of the stock rail and are locked. The motor-control contacts control the motor-operating circuit either directly or in conjunction with the optional biased-neutral controller.

The Model 55 is equipped with renewable, one-piece, box-style wear plates for the throw bar and the lock and detector rods.

INSTALLATION AND ADJUSTMENT

Satisfactory operation of the Model 55 switch machine depends upon correct installation, adjustment, and maintenance. Also, the switch layout must be maintained in good condition.

Install the switch machine in accordance with the switch layout approved by your railroad. Adjust and maintain the machine in accordance with the instructions which follow. Check that the condition of the switch layout is in accordance with the railroad's specifications, and that it is well drained to protect against the accumulation of water around the machine.

Right- or Left-Hand Layout

The Model 55 switch machine, Figure 1, is supplied for right-hand operation only. It can be changed to left-hand operation in the field by reversing the throw bar connection and the lock and point-detector rods in the machine. First change the connection from one end of the throw bar to the other end, then proceed as follows:

1. Remove the lug with the adjacent lock and adjusting nuts from the solid-through lock rod.
2. Crank the machine to the unlocked position.
3. Pull the lock rod as a unit out of one side of the machine and insert it into the machine from the opposite side.
4. Replace the lug and lock and adjusting nuts on the solid-through lock rod.
5. Remove the lug with adjacent lock and adjusting nuts from the solid-through point-detector rod.
6. Pull the point-detector rod as a unit out of one side of the machine and insert

it into the opposite side.

7. Replace the lug and lock and adjusting nuts on the solid-through point-detector rod.

Mounting

The ties which support the switch machine and the switch must be well tamped for their entire length to withstand vibration. The two extended ties which support the machine must also be reasonably straight and, where required, properly framed.

Mount the machine and fasten it securely to the ties so that there will be no movement of the machine with respect to the rails. Follow your railroad's mounting and layout plans for the particular location.

Wiring

The motor, point detector, and optional biased-neutral controller are completely wired at the factory. In the field, bring the external wires for switch control, motor energy, and repeater relay circuits into the machine through a suitable wire entrance fitting, and connect to terminals on the point detector. Follow your railroad's detailed wiring plan for the location.

Typical Model 55 wiring diagrams and control circuits are shown in Figures 2 and 3. Figures 4 through 7 show typical polarized and neutral switch repeater relay circuits.

Throw Rod - To Connect and Adjust

1. Remove the guard over the throw bar.
2. Connect the throw rod to the switch basket and to the throw bar.
3. Crank the machine to the end of its stroke. The stroke is 6 inches.
4. Adjust the nuts at the switch basket to obtain proper pressure at the switch points. Lock the nuts in this position. Avoid excessive pressure.
5. Crank the machine to the opposite position and repeat step 3.
6. Crank the machine back and forth several times as a final check.

Point-Detector Rod - To Connect and Adjust (Before adjusting lock rod)

1. Remove the guards over the lock and detector rods.
2. Fasten the point-detector connecting rod to the switch and to the point-detector rod in the machine. Follow the approved layout plan for the location.
3. Crank the machine to close and lock the near switch point.
4. Adjust the rod connected to the near switch point until the locating notch on

the top of the rod, on the track side of the machine, is even with the finished edge on the point-detector casting. Tighten and lock the nuts.

5. Crank the machine to close and lock the far switch point.

6. Move the adjusting plate of the point-detector rod until the locating notch on the top of the rod, on the track side of the machine, is even with the finished edge on the point-detector casting. Tighten and lock the nuts.

7. After adjustments in both directions have been made, crank the machine back and forth several times to check that the locating notches return to the proper position at the end of each throw-bar stroke.

NOTE: The locating notches on the point-detector rod indicate only that the normal or reverse indication contacts will open if the detector rod moves approximately 1/4 inch toward the open point position. Final adjustments must be made in accordance with AAR or railroad instructions.

Lock Rod - To Connect and Adjust

1. Position the lug on the lock rod in the center of the threaded section. Tighten and lock the nuts against each side.

2. Assemble the lock-rod connecting rod to the lug on the front rod and to the lug on the lock rod.

3. Crank the machine to close, but not lock, the near switch point. Move the lock rod until the locating notch on the top of the rod is even with the finished edge of the point-detector casting. Tighten and lock the nuts on the lock-rod connecting rod against each side of the lug on the front rod to maintain this adjustment.

4. Crank the machine to close, but not lock, the far switch point. Move the adjusting plate of the lock rod until the locating notch on the top of this plate, on the field side of the machine, is even with the finished edge of the point-detector casting. Tighten and lock the nuts that hold this adjustment.

5. After adjustments in both directions have been made, crank the machine back and forth several times to check that the locating notches return to the proper position at the end of each throw-bar stroke.

NOTE: The locating notches on the lock rod indicate only that the lock dog is in the center of the locating notches. Final adjustments must be made in accordance with AAR or railroad instructions.

MAINTENANCE

CAUTION: DISCONNECT THE MOTOR ENERGY WHENEVER THE GEAR COVER IS REMOVED

Lubrication

Lubricate the switch machine thoroughly before it is placed in regular service. Follow the railroad's schedule for subsequent periodic inspection and lubrication, or establish a routine lubrication program based on the number of switch operations and the operating conditions at the switch location. The switch machine requires only minimum lubrication. The motor and gear units are equipped with either sealed bearings or oilite bushings which do not require lubrication in service.

Lubricate all gear teeth with an adhesive type grease, such as Socony Mobil Company's Mobilplex #1.

Use an all-temperature grease, such as Socony Mobil Company's Mobilux #1, on the sides and hubs of gears, exposed gear shafts, and on all sliding surfaces.

Lubricate the six rollers in the point-detector movement with a lightweight motor oil.

Avoid the use of too much grease and oil. Any excess should be removed. Do not permit grease and oil to drop or collect on wires, contacts, etc.

Holding Device - Annual Inspection

1. Remove the two screws which hold the cover in place.
2. Check that all screws are tight.
3. Check that the motor armature and attached magnet rotate freely.
4. There should be no end play in the armature shaft. The design of the motor automatically eliminates armature end play.
5. Replace the cover.

Motor

1. Motor field connections - motors are furnished with series split-connected field coils. The internal arrangement of the field coils does not permit changes in the field coil arrangement.
2. Commutator and brushes - after a new or reconditioned motor has been in service, the area of the commutator which comes in contact with the brushes should become coffee-colored and highly polished. This is a normal condition. Keep the commutator smooth and free of dust, grease, or oil. Brushes should slide freely in their holders and seat fully on the commutator. Brush pressure is regulated by the spring attached to each brush. Replace brushes when worn to within 3/8 inch on their centerline. New brushes do not require fitting to the commutator.

   If brushes are removed for inspection, be sure to replace them in the same position within their original holders.

Cranking

It is recommended that the machine be operated by hand, before applying power, to check that adjustments are properly made, and that no undue strain is placed on the switch machine parts. A hand crank is provided for this purpose.

To crank the machine, open the crank hole cover and move the cutout contact plate upward. See Figure 1. This action opens the motor circuit and permits insertion of the hand crank. To return to power operation, remove the crank and move the cutout contact plate downward to restore the contact to its closed position.

The cutout contact should be kept clean. Contact pressure should be from 12 to 20 ounces; the contact opening should not be less than 1/4 inch.

Overload Friction Clutch

Test the clutch slipping current when placing the machine in service and at scheduled intervals thereafter. Proceed as follows:

1. Place an obstruction between the switch point and the stock rail.
2. Connect an ammeter in series with the motor.
3. Shunt out the operating winding of the external overload relay (if used).
4. Operate the switch against the obstruction.
5. Read the motor current as the clutch slips. It should be approximately 9 amperes for the 110-volt machine and 12 amperes for the 24-volt machine.
6. Remove the shunt on the overload relay.

If the slipping current is not within the railroad's tolerances, adjust the clutch as follows:

1. Crank the machine to the unlocked position.
2. Back off the setscrew that holds the clutch adjusting nut.
3. With the clutch adjusting wrench (GRS Drawing 36593-29), turn the adjusting nut clockwise to increase the slipping current; counterclockwise to decrease the slipping current. Tighten the setscrew.
4. Shunt out the operating winding of the overload relay. Test the clutch again to determine the slipping current. Remove the shunt on the overload relay.
5. Check the operation of the overload relay.
6. As a final check, power operate the machine to its full normal and reverse positions.

Point Detector

Periodically check that the point-detector contacts are properly adjusted by observing that the rollers in the point-detector movement rest firmly on the bottom

REPLACEMENT PAGE 8

REVISION FOR PAMPHLET 1217, MARCH 1965 EDITION

GRS MODEL 55 ELECTRIC SWITCH MACHINE

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of the slots in the point-detector and lock rods in both the normal and reverse positions. The fully-closed position for the normal and reverse contacts is shown in Figure 8. This position for the motor-control contacts is shown in Figure 9.

The contact pressure for the fully-closed normal and reverse contacts, measured very near the point of contact, should be approximately 3 pounds. To decrease the pressure of a normal or reverse contact, bend in the U-shaped spring. To increase the pressure, release the U-shaped spring from its stop and bend out the spring.

The contact pressure of the motor-control contacts, determined by the coil spring and the contact opening, is not adjustable.

To adjust normal and reverse contacts C5 to C8 and D1 to D4, Figure 8, proceed as follows:

1. Adjust the contacts on each side to close and open at the same time.
2. With the contacts fully closed, the distance between U-shaped spring 3 and front stop 2 should not be more than 1/16 inch or less than 1/32 inch.
3. To adjust this distance for all contacts, loosen the two screws in each contact block assembly and move it in or out, as required. Tighten the assembly after adjustment. To adjust an individual contact, bend finger 1 at point X.

To adjust motor-control contacts C1, C2, D7, and D8, Figure 9, after adjusting the normal and reverse contacts, proceed as follows:

1. The contact opening of the motor-control contacts of a 24-volt machine should be from 3/64 inch to 1/16 inch when the related normal or reverse contact just closes. In a 110-volt machine, the contact opening should be from 3/16 inch to 1/4 inch. This opening may be adjusted by loosening screw 2, lifting the adjuster tip out of its hole, and moving contact 1 in or out, as required. Retain this adjustment by setting the adjuster tip in a new hole and tightening the screw.
2. Adjust the tip of the movable contact for a wipe of from 1/64 inch to 1/32 inch.

Wear Plates

The throw bar and the lock and detector rods are equipped with one-piece, outside, box-style wear plates. The lock rod, in addition, has a flat, inside wear plate on each side of the locking bar. Periodically, examine all plates for wear.

To remove an outside wear plate from the throw bar, proceed as follows:

1. Remove the guard over the throw bar.
2. If the wear plate is on the track side of the machine, disconnect the throw rod from the throw bar. Omit this procedure if the wear plate is on the field side of the machine.

3. Remove the two screws and plate which hold the wear plate to the base casting. Remove the wear plate over the end of the throw bar.

4. Install the new wear plate by reversing the disassembly procedure.

5. If the throw rod is disconnected from the throw bar, adjust as described previously under "Throw Rod - To Connect and Adjust."

To remove an outside wear plate from either the lock or detector rod, proceed as follows:

1. Remove the guard over the lock and detector rods.

2. Disconnect either the lock- or detector-connecting rod and lug from its respective rod in the machine.

3. Remove the point detector as a unit with wiring attached.

4. Lift up the particular rod to release the outside wear plate from its locking pin in the base casting. Remove the plate over the end of the particular rod.

5. Install the new plate by reversing the disassembly procedure.

6. Adjust the particular rod as described previously.

To remove an inside wear plate from the lock rod, proceed as follows:

1. Remove the guard over the lock and detector rods.

2. Disconnect the lock-rod connecting rod from the lock rod in the machine.

3. Remove the point detector as a unit with wiring attached.

4. Lift up and move the lock rod to one side.

5. Remove the two flat-head screws which hold each inside plate to the base casting.

6. Install the new wear plates, checking that each plate is securely fastened to the base casting.

7. Adjust the lock rod as described previously.

OPTIONAL EQUIPMENT

Biased-Neutral Controller

The Model 55 switch machine is available with a built-in biased-neutral controller which provides for two-wire polarized control, either normally energized or deenergized. Overload protection is self-contained.

The controller consists of two biased-neutral contactors (C1 and C2), a centering device, a blocking rectifier, and an overload relay. The components are housed in a shock-mounted, aluminum case provided with a terminal board. Figure 1

shows the location of the controller within the Model 55 switch machine. A typical switch machine circuit with controller arrangement is shown in Figure 10.

For maintenance purposes, it is recommended that the controller be changed out as a unit, rather than changing out any of its components separately. Proceed as follows:

1. Disconnect the motor energy.
2. Remove the cover from the controller.
3. Remove the four screws which secure the controller to the resilient mounting springs.
4. Lift out the controller with wiring attached.
5. Disconnect the wiring. The wiring harness may be removed from one controller and reconnected to a spare controller.

To replace the controller in the machine, proceed as follows:

1. Crank the switch machine to the unlocked position so that the bottom of the controller will just clear the dog on the locking bar. It should move freely in any direction, but must not touch other parts of the machine except through the resilient mounting springs.
2. Reconnect the wires, checking that they are arranged to permit free movement of the controller.
3. Securely fasten the case to the resilient mounting springs.
4. Operate the machine to the fully unlocked position. Check that the controller case does not touch the dog on the locking bar.

Periodic maintenance and adjustment procedures are as follows:

1. Lubrication - apply a drop of lightweight motor oil to the barrel-shaped pin protruding from the top of each armature, and on the bearings of the contactor centering shaft.
2. Contactors - the contacts are adjusted with shims placed behind the contact bolt to obtain the correct contact opening. See Figure 11. Adjust the contacts for an opening of from 0.385 to 0.405 inch so that the front contact just closes when the armature is from 0.030 to 0.040 inch away from the upper residual pin in the top pole piece. This adjustment provides the necessary contact wipe. Periodically, inspect the contacts for sufficient contact wipe. Replace worn contacts, if required.

   The permanent magnet blowouts for the contacts are stamped "N" to indicate the north pole of each magnet. If the magnets are removed, be sure to reassemble them in their original positions with respect to magnetic polarity.

3. Centering device - shims behind the upper bearing support of the contactor centering shaft permit the centering device to be positioned properly so that the back contact of one contactor will close at the same time, or slightly before, the front contact of the other contactor.

   Contact pressure should not be less than 256 grams (9 ounces); contact resistance should not exceed 0.1 ohm. The proper electrical values are shown in Figure 12. If working current is too high, adjust the horizontal spring, as required, to change the position of the nuts which hold it in compression.

4. Blocking rectifier - connected between the coils of each biased-neutral contactor to protect against the effects of lightning. To test the blocking rectifier, place a milliammeter in the control circuit. The current should not exceed 0.025 ampere when the machine is over and locked in either the full normal or full reverse position.

NOTE: Do not operate the machine while this test is in progress.

5. Overload relay - factory adjusted to pick up in approximately three seconds after the clutch begins to slip. Maintain at least 0.010-inch clearance between spring 3 and stop 4 when the relay is deenergized. See Figure 13. When the relay is picked up, spring 3 must rest against stop 4. The deenergized contact pressure - 90 to 100 grams - is measured by placing a 0.010-inch feeler between spring 3 and stop 4, and applying pressure to the contact on spring 5 until the contact opens. The contact opening with the armature picked up should be 0.030 to 0.040 inch. If required, adjust the contact opening by carefully bending arm 2.

   Check the operation of the overload relay approximately once every three months, or whenever a change is made in the clutch setting. Proceed as follows:

   a. Place an obstruction between the switch point and the rail.

   b. Operate the switch against the obstruction.

   c. Note the pickup time for the overload relay when the switch encounters the obstruction. Three to a maximum of ten seconds is recommended. A minor variation may be expected between tests in both directions.

   d. To increase the pickup time, turn slotted-head nut 1 clockwise; to decrease the pickup time, turn counterclockwise.

POINT

LOCK ROD

THROW BAR

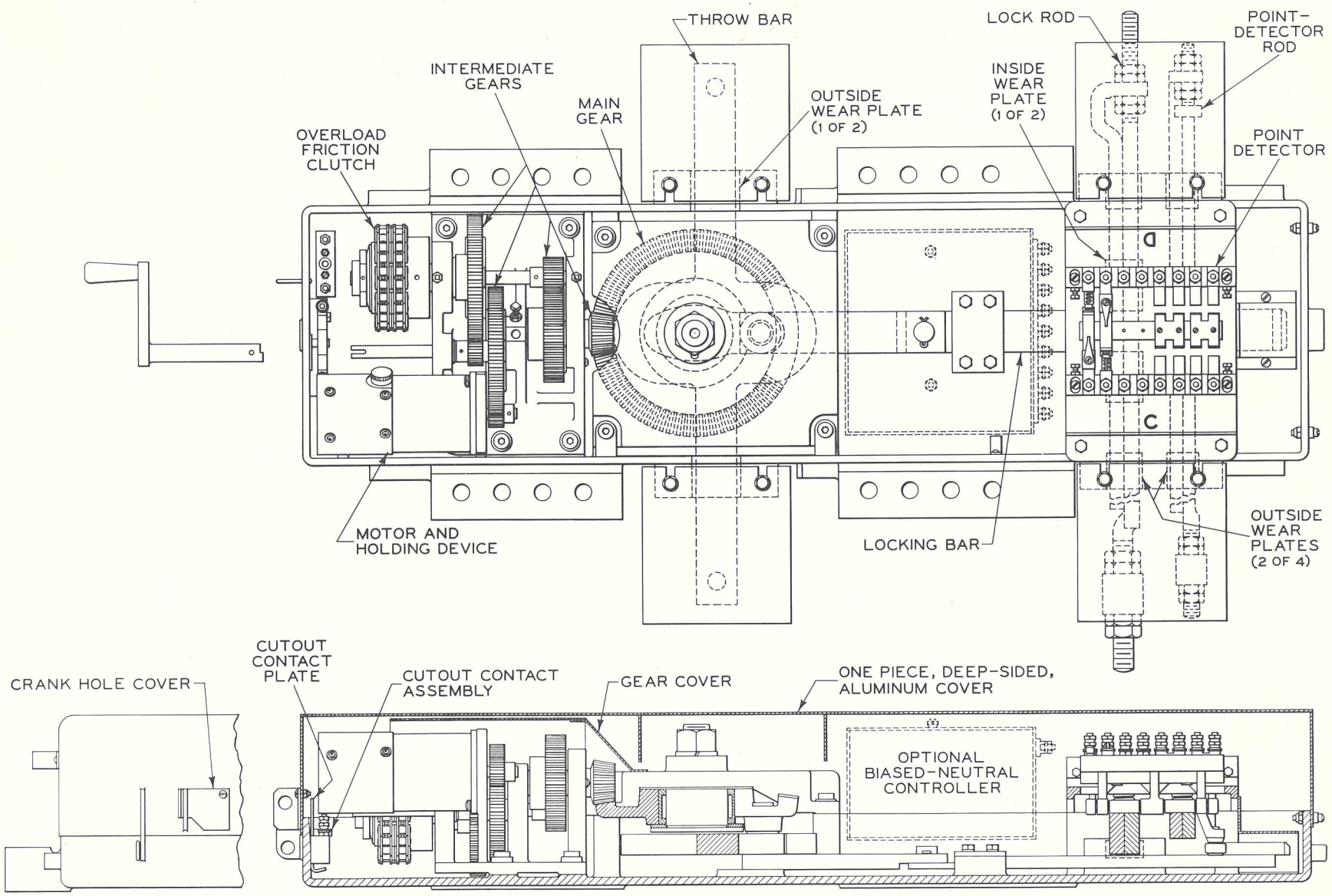


Figure 1. Assembly drawing of Model 55 switch machine.

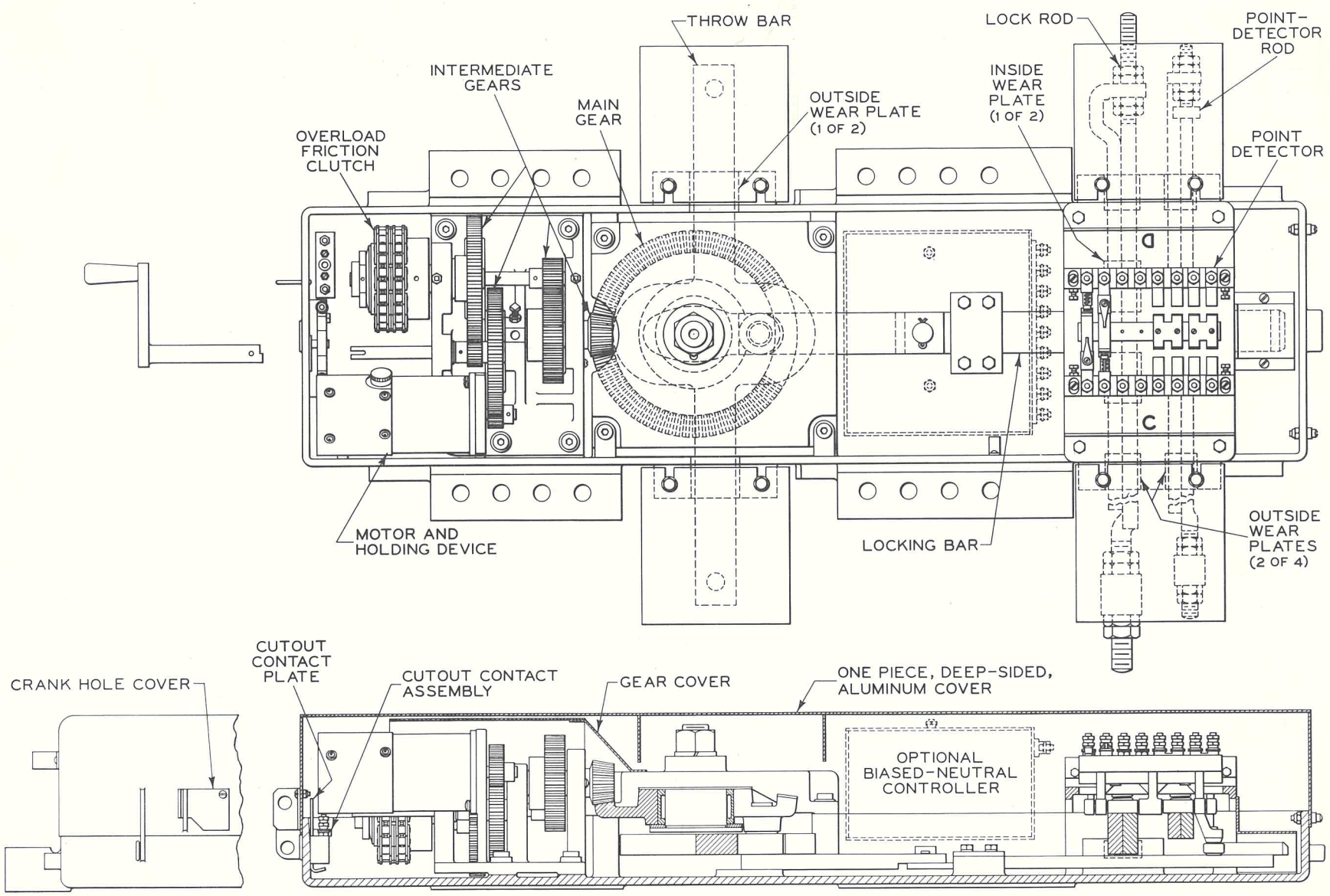
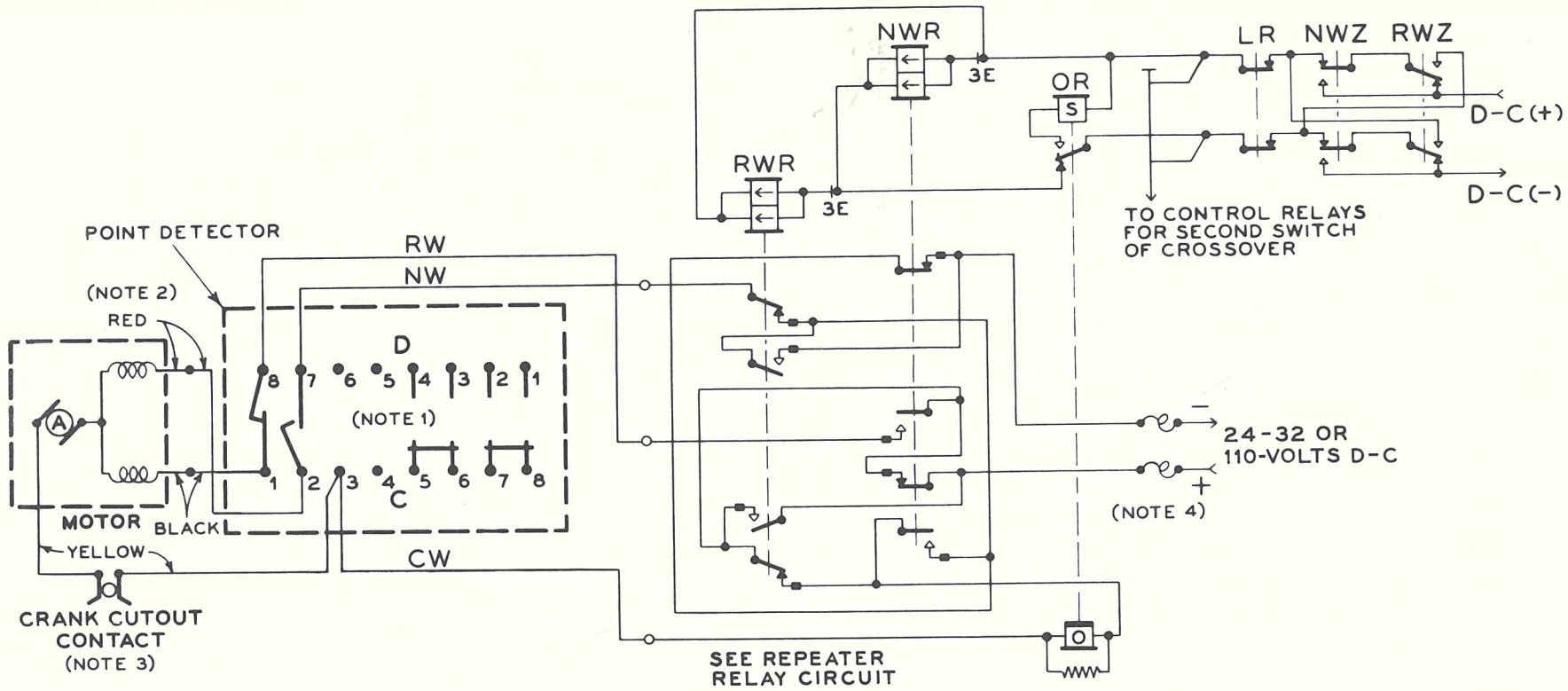


Figure 1. Assembly drawing of Model 55 switch machine.



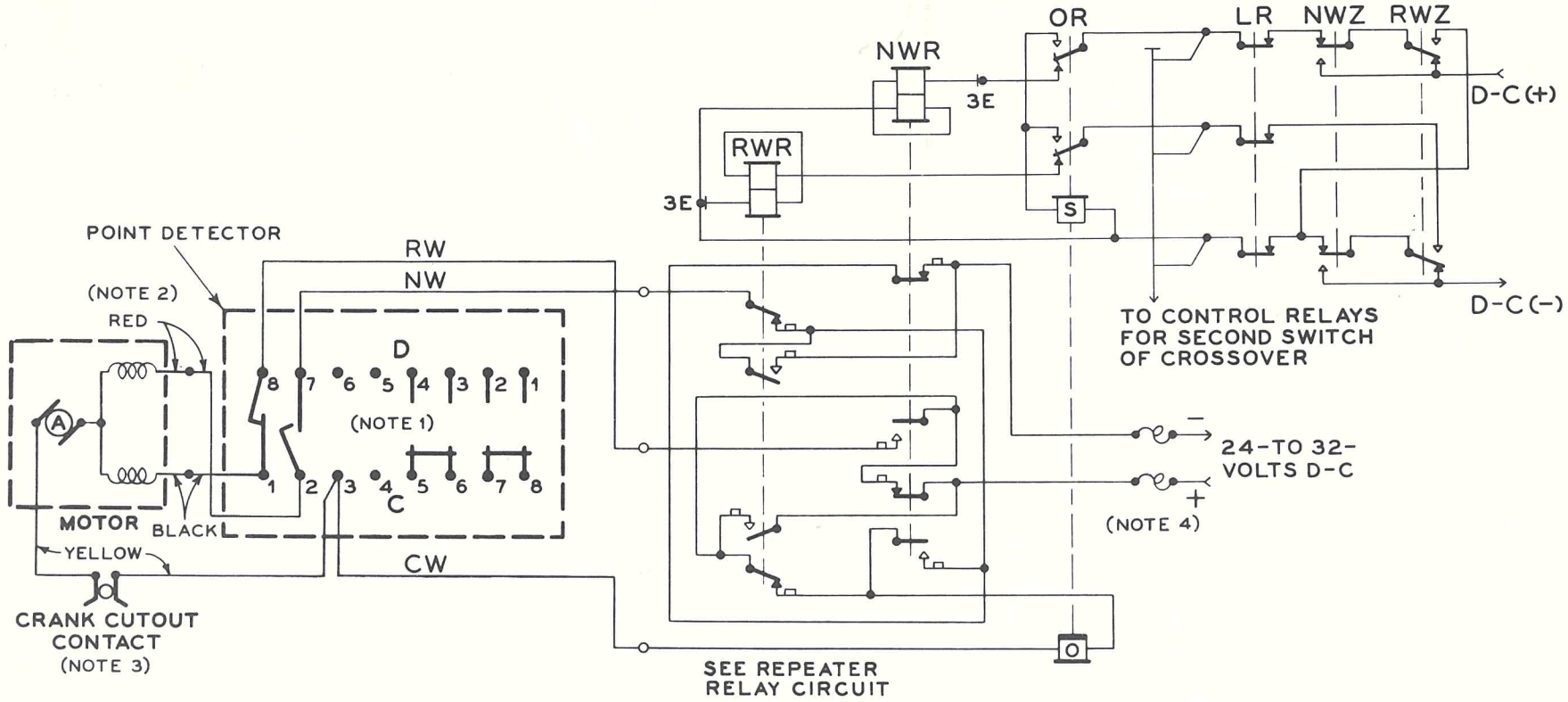
NOTE 1. Point-detector contacts are shown in position for right-hand point normally closed. For normally closed left-hand point, transpose the NW and RW wires.

NOTE 2. To operate a block-type derail, transpose the black and red wires.

NOTE 3. The crank cutout contact opens the motor circuit when the hand crank is inserted.

NOTE 4. 5-amp Fusetrons are used with 110-volt machines; 10-amp Fusetrons with 24- to 32-volt machines.

Figure 2. Typical Model 55 wiring diagram and two-wire control circuit, right-hand point normally closed.



NOTE 1. Point-detector contacts are shown in position for right-hand point normally closed. For normally closed left-hand point, transpose the NW and RW wires.

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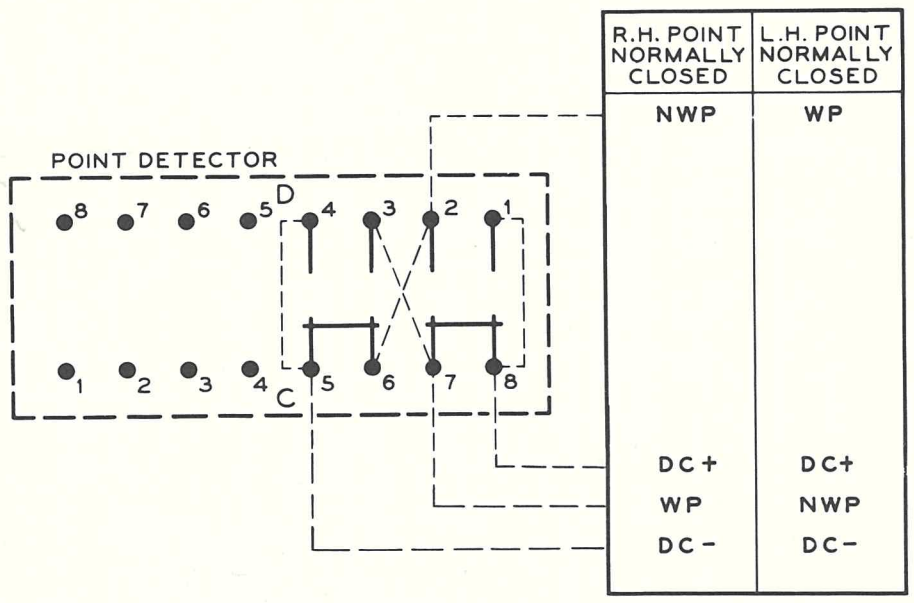
NOTE 3. The crank cutout contact opens the motor circuit when the hand crank is inserted.

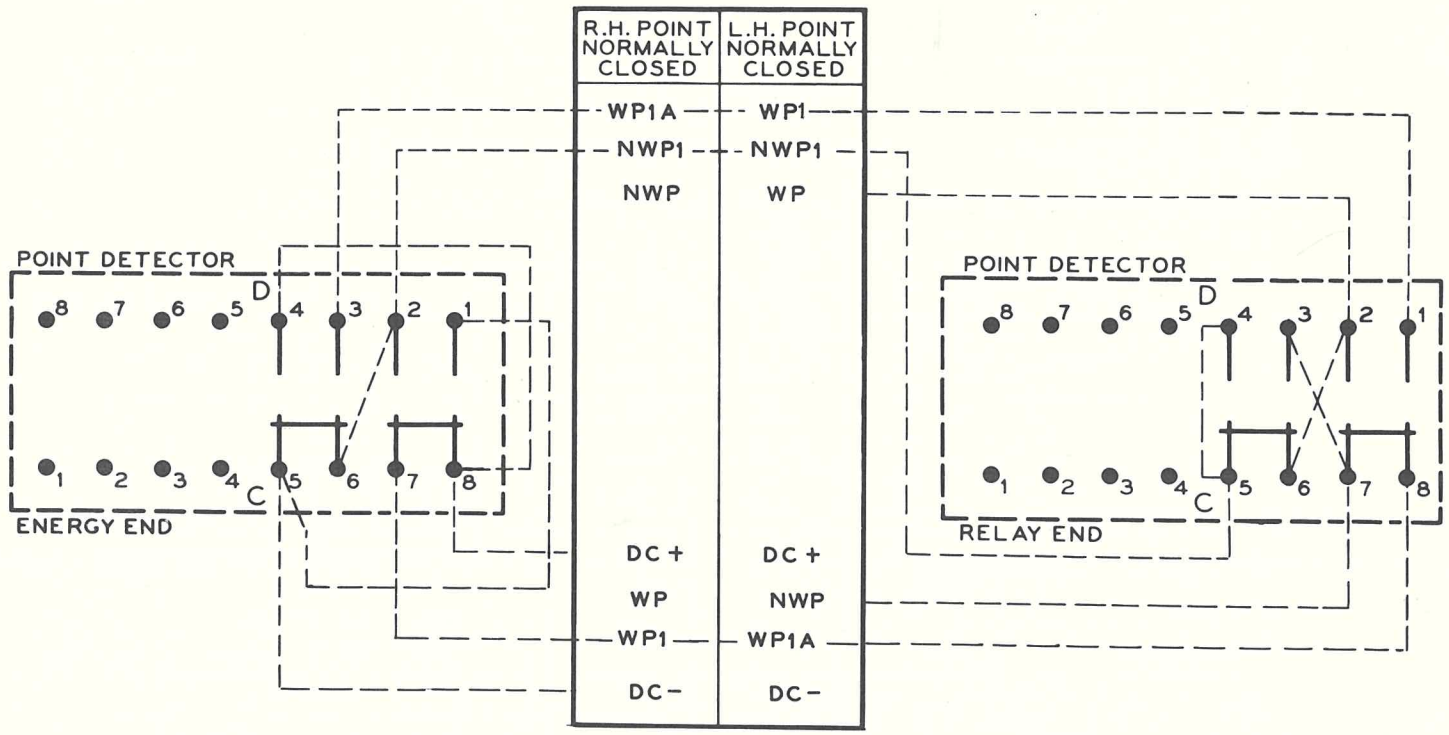
NOTE 4. 10-amp Fusetrons are used with 24- to 32-volt machines.

Figure 3. Typical Model 55 wiring diagram and three-wire control circuit, right-hand point normally closed.



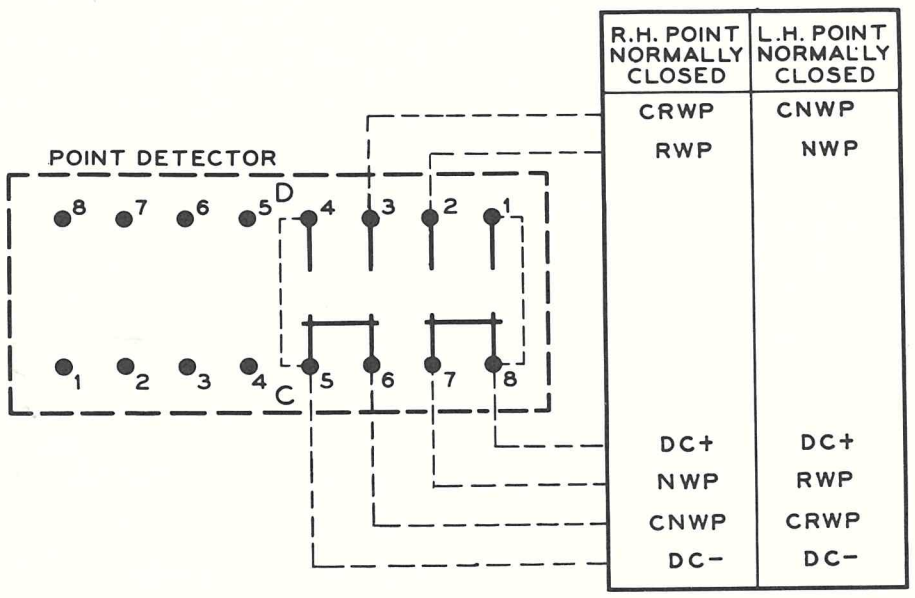
NOTE: Point-detector contacts are shown in position for right-hand point normally closed.

Figure 4. Typical polarized switch repeater relay circuit, single switch.



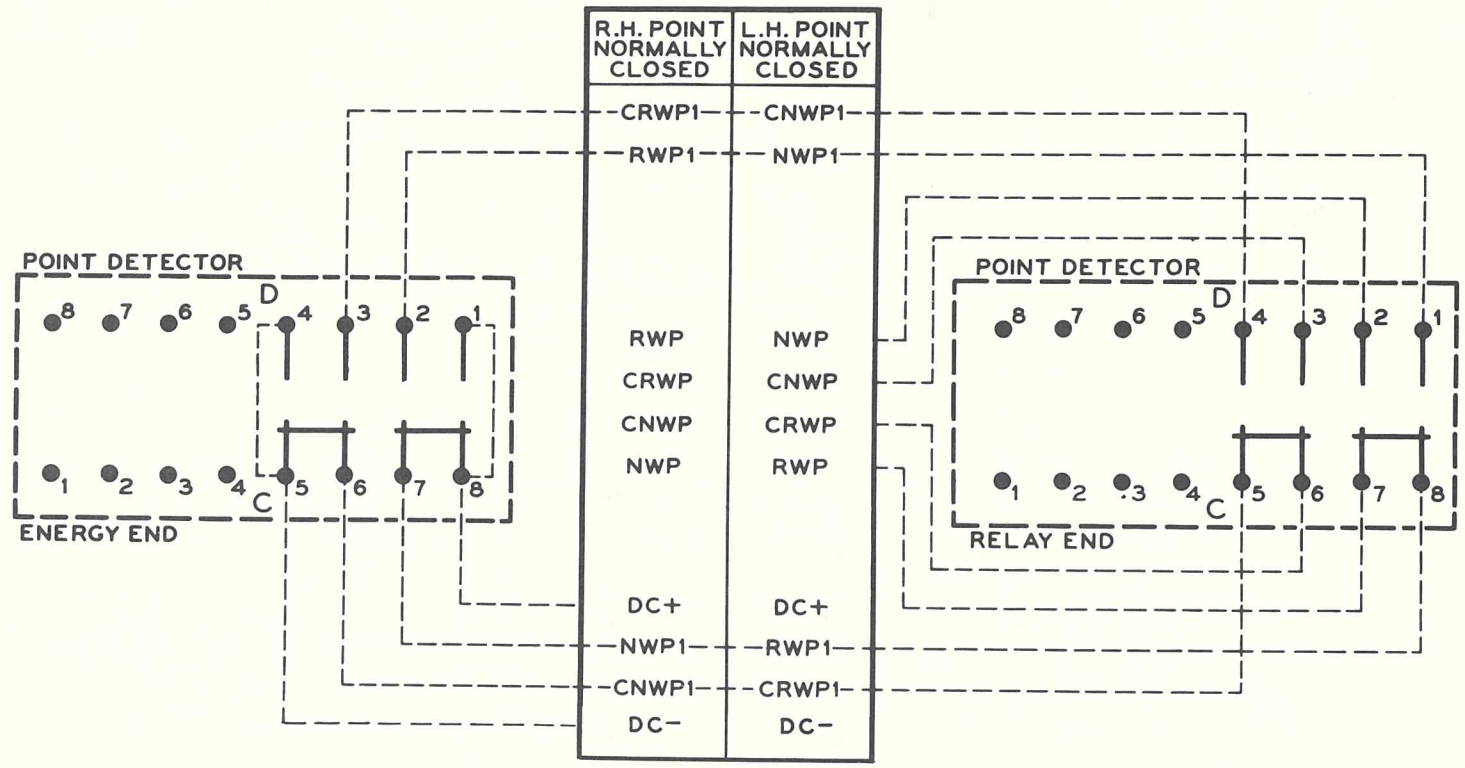
NOTE: Point-detector contacts are shown in position for right-hand point normally closed.

Figure 5. Typical polarized switch repeater relay circuit, crossover.



NOTE: Point-detector contacts are shown in position for right-hand point normally closed.

Figure 6. Typical neutral switch repeater relay circuit, single switch.



NOTE: Point-detector contacts are shown in position for right-hand point normally closed.

Figure 7. Typical neutral switch repeater relay circuit, crossover.

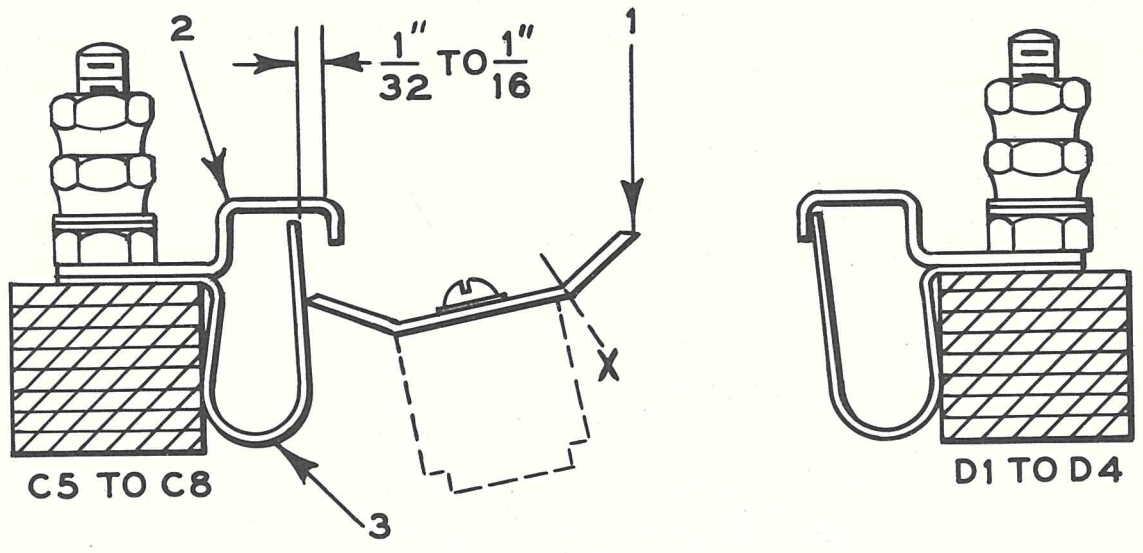


Figure 8. Normal and reverse contacts.

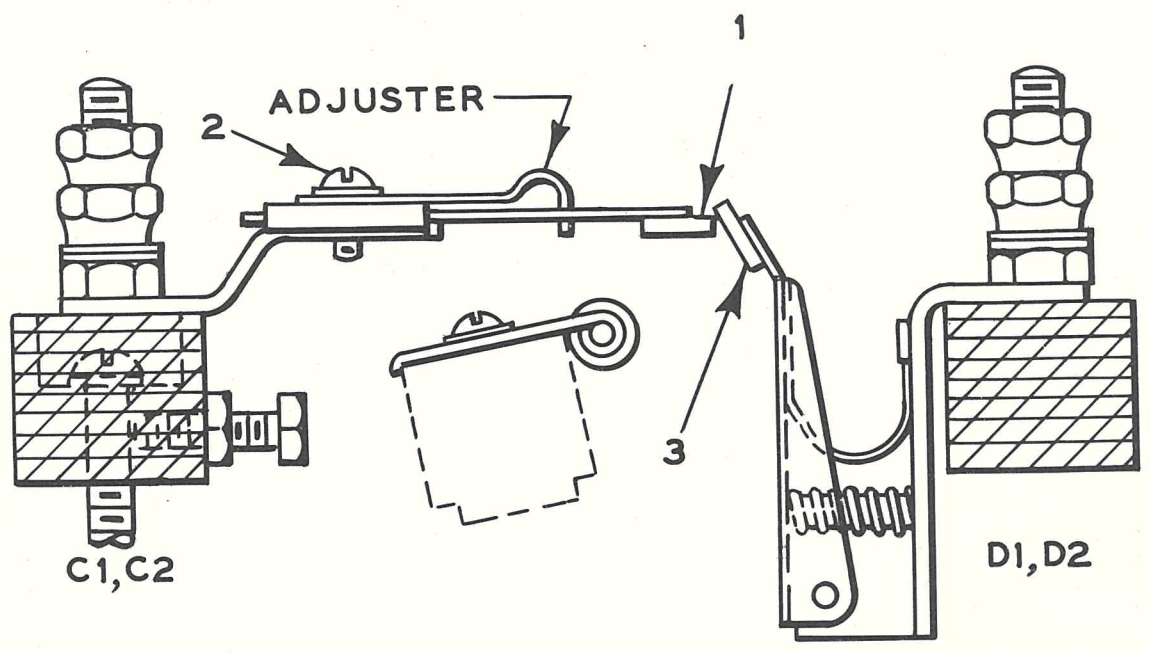


Figure 9. Motor-control contacts.

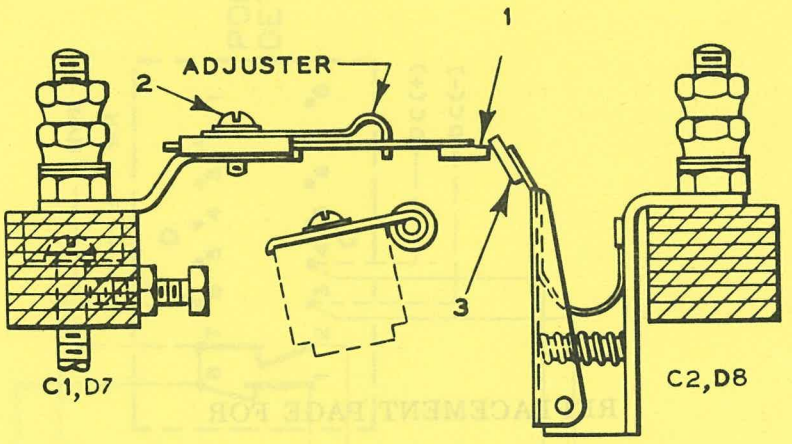
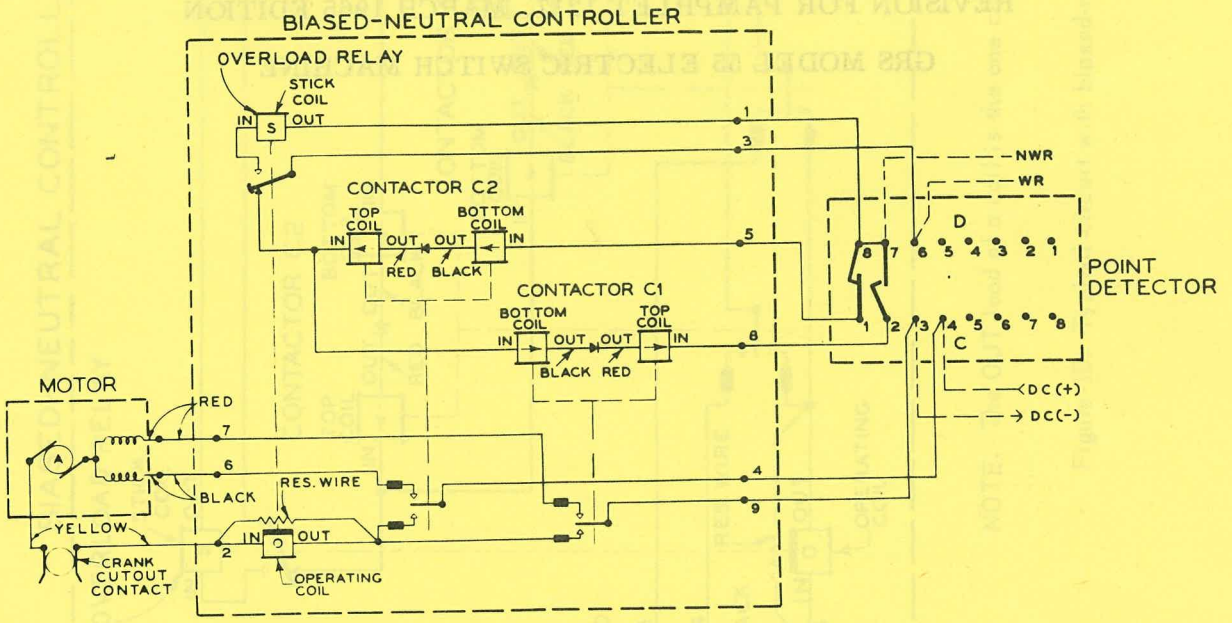
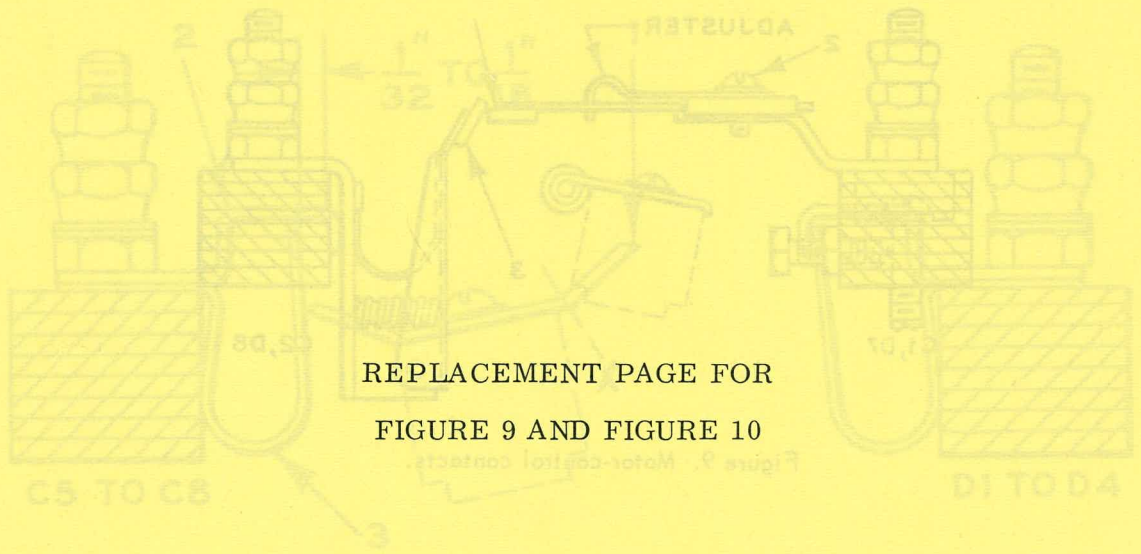


Figure 9. Motor-control contacts.



NOTE. The OUT lead of a coil is the one closer to the tag on the coil.

Figure 10. Typical circuit with biased-neutral controller.

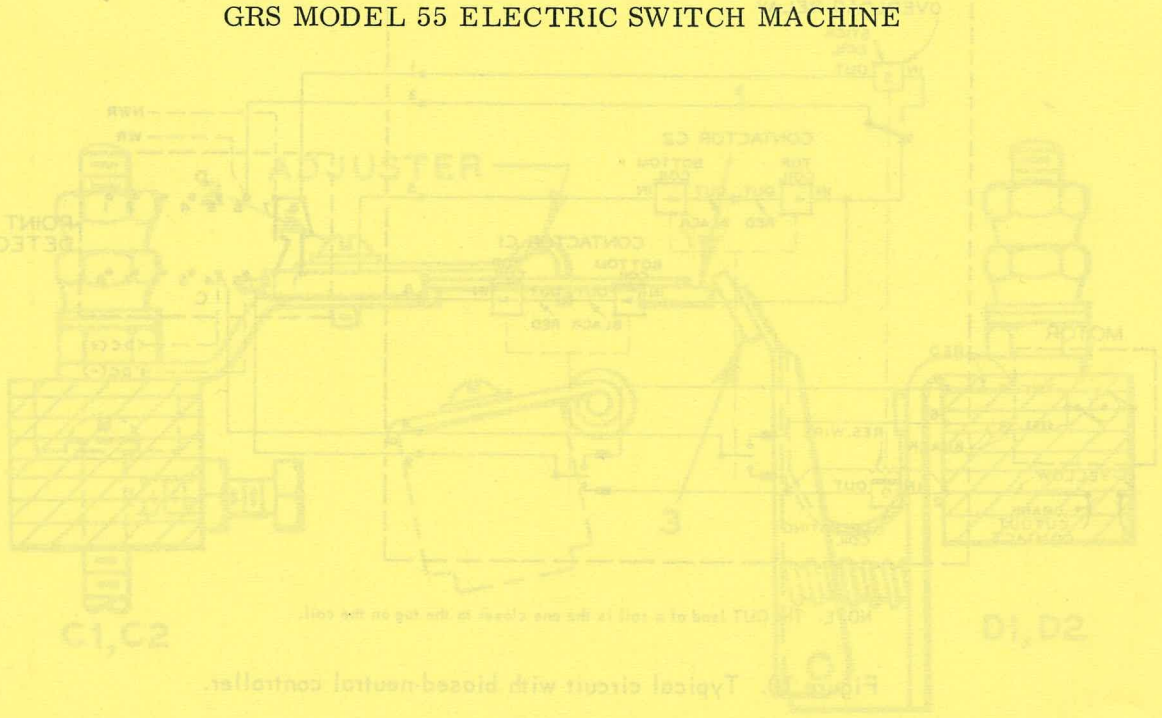


REPLACEMENT PAGE FOR

FIGURE 9 AND FIGURE 10

REVISION FOR PAMPHLET 1217, MARCH 1965 EDITION

GRS MODEL 55 ELECTRIC SWITCH MACHINE



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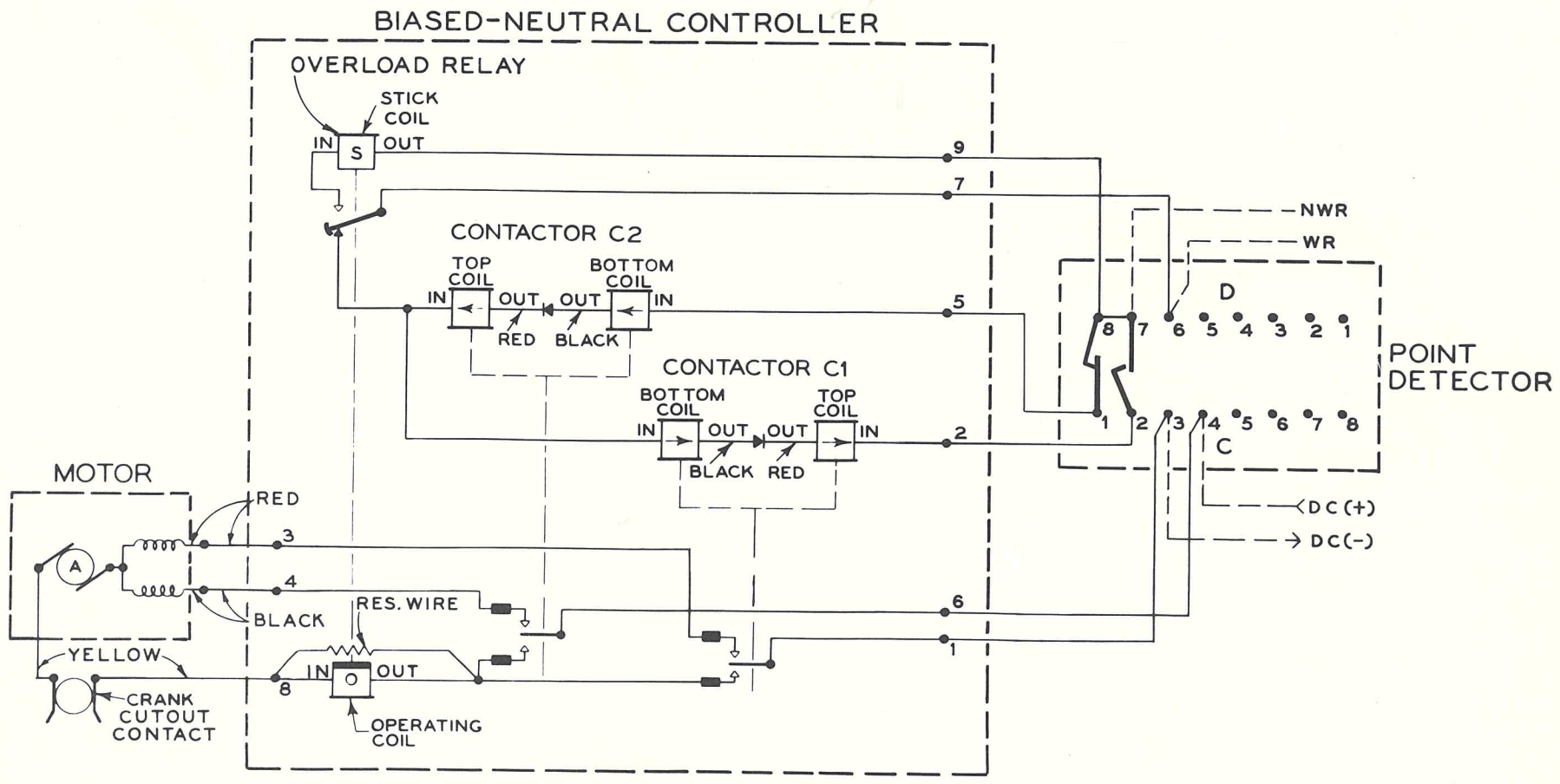


NOTE. The OUT lead of a coil is the one closer to the tag on the coil.

Figure 10. Typical circuit with biased-neutral controller.

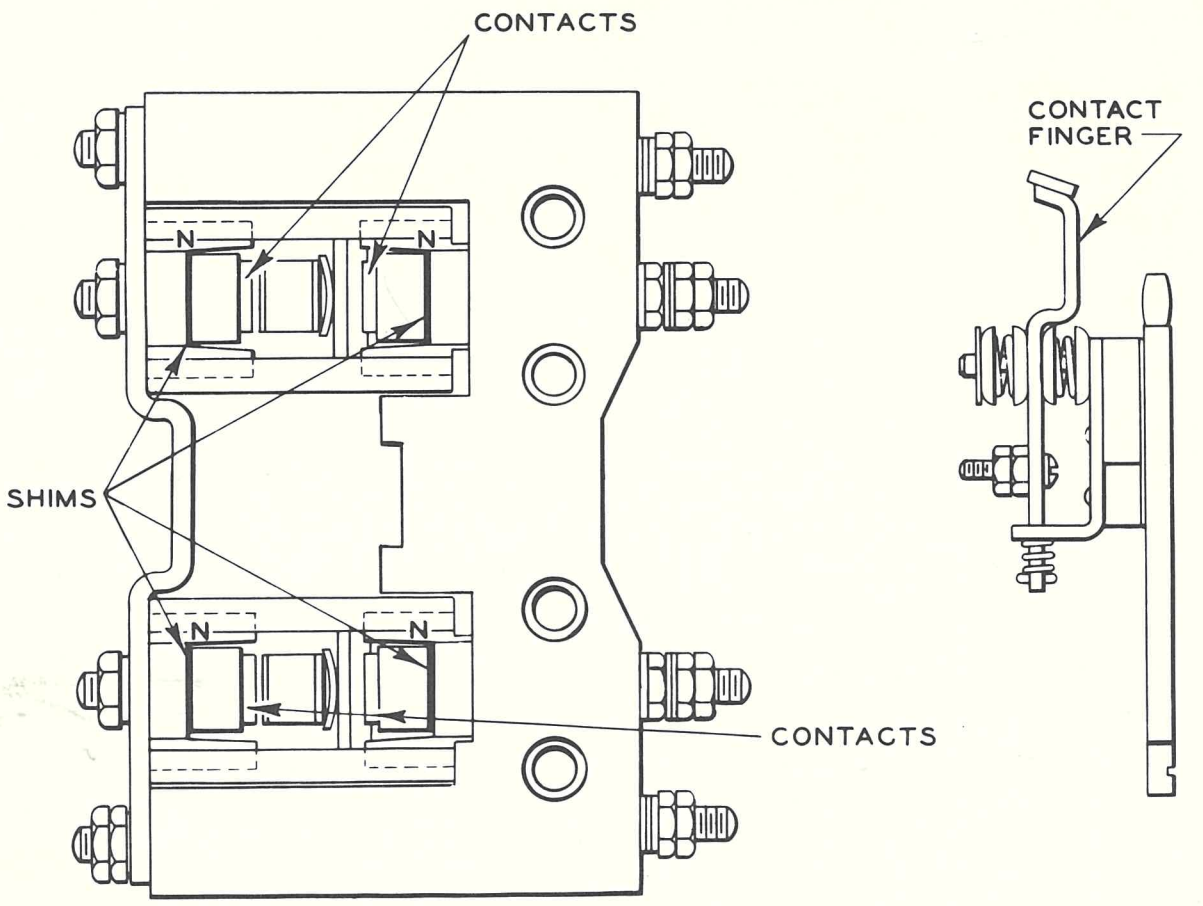


Figure 11. Biased-neutral controller contact structure.

Nominal Control Voltage	Resistance (Ohms)		Working Current	Dropaway Current
	Each Contactor	Rectifier (Forward)	Not to Exceed	Not Less Than
10-12	36	7 (approx.)	0.140	0.026
24-32	250	30 (approx.)	0.055	0.010

Figure 12. Operating values of biased-neutral contactors at 70 degrees F.

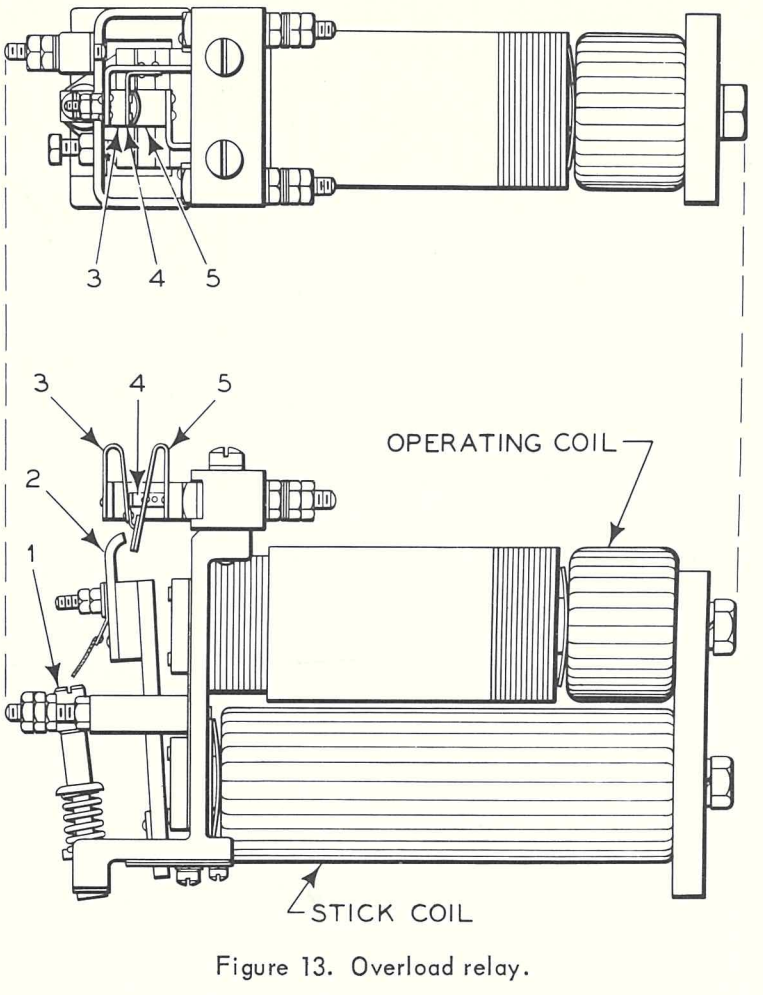


Figure 13. Overload relay.

GRS

INTRODUCTION

GRS Models 5A, 5E, 5F, 5G and 5H electric switch machines are for use in mainline, interlocking, and rapid transit service. Model 5A switch machines are for use only in applications requiring direct operation, dynamic indication for older style interlocking machines. All models operate a single switch, single-slip switch, double-slip switch, or derail, regardless of variations in switch fitting standards and weight of rail.

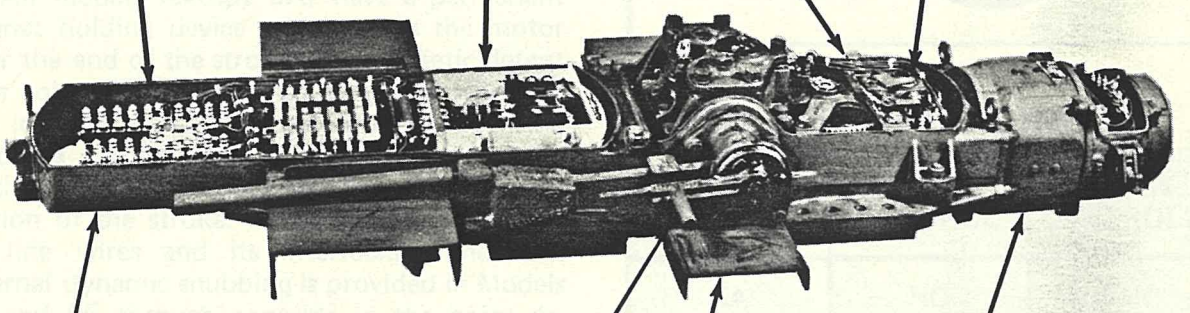
All machines are compact, mount on only two ties, and fit the same standardized layout. They meet the requirements of A.A.R. Load Curve 1457, thus providing ample thrust to operate the heaviest switches.

POINT DETECTOR is an over-and-locked type circuit controller with two normal, two reverse, two shunt and two motor-control contacts. The normal and reverse contacts check and indicate when the switch points are within the proper distance of the stock rail and are locked. The motor control contacts control the motor operating circuit directly in Models 5E and 5F machines and in conjunction with the biased-neutral controller in Models 5G and 5H machines.

BIASED-NEUTRAL CONTROLLER in Models 5G and 5H machines has two biased-neutral, mechanically interlocked contactors, a blocking rectifier, and an overload relay. Each contactor has one dependent, front-back contact with a permanent magnet blowout (arc suppression). A snubbing contact provides dynamic motor braking at the end of the stroke. The magnetic structure prohibits armature operation until voltage of the proper polarity is applied across the coils.

OVERLOAD FRICTION CLUTCH in the gear train absorbs shocks encountered in switch operation. It is factory adjusted to slip when the motor operating current is from 12 to 14 amperes for 110-volt machines, and 18 to 20 amperes for 24-volt machines. The clutch in Models 5F and 5H can be removed without disassembling the dual control mechanism.

REMOVABLE HAND CRANK is available on all Model 5 machines for maintenance and emergency use. An automatic cutout contact with a latchout feature and manual reset protects the operator.



HEATERS are provided in the motor, controller, and point detector compartments.

The machines have renewable box style bearings for the throw bar, and wear plates for the lock and detector rods.

DUAL CONTROL MECHANISM in Models 5F and 5H machines permits either power or hand-throw operation.

6-inch stroke

RUGGED MOTOR provides long, reliable service. It has series split connected epoxy-coated insulated field coils and an epoxy-coated armature. Dynamic snubbing limits motor overrun at the end of the stroke, and a simple magnetic detent holding device then locks the motor armature. Magnetic holding is frictionless and virtually maintenance-free -- nothing to wear out.

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DESCRIPTION

Models 5A, 5E, 5F, 5G and 5H switch machines basically consist of an electrically operated switch and lock movement, with lock rod, point detector rod and built-in contacts that check the machine over-and-locked in both the normal and reverse positions.

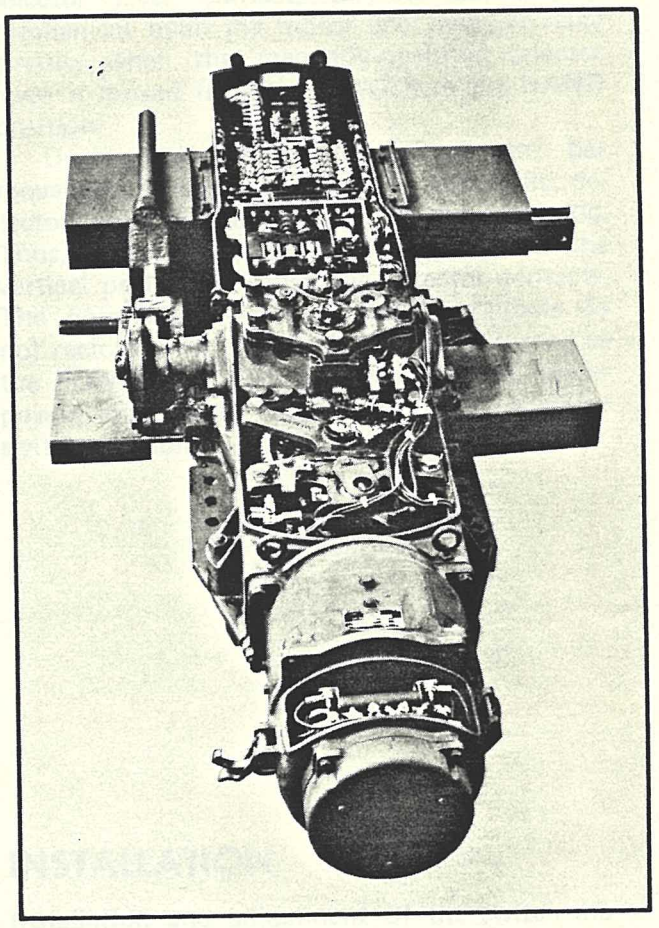
Models 5A, 5E and 5G machines are designed for power operation only; Models 5F and 5H machines have a dual control mechanism which permits either power or hand-throw operation. All models can be hand cranked for making and checking adjustments; for power-only models, hand cranking is used for emergency switch operation in case of power failure.

Control and overload relays for Models 5E and 5F are housed externally. Models 5G and 5H have a built-in biased-neutral controller operated by a low-voltage d-c, two-wire polarized line circuit. The controller, in turn, applies 24- or 110-volt d-c to the motor. This control voltage can be easily changed in the field from 24 to 10 volts to suit railroad requirements. All models (except 5A) are designed for battery indication.

Operating time is approximately 3 seconds for 110-volt machines and 8 to 10 seconds for 24-volt machines.

All models (except 5A) have a permanent magnet holding device which holds the motor after the end of the stroke. The magnetic detent then holds the motor armature against vibration and low-level stray electrical currents. Dynamic snubbing on all models serves to bring the machine to rest without shock upon the completion of the stroke. Model 5A snubs through its line wires and its interlocking machine. Internal dynamic snubbing is provided in Models 5E and 5F through contacts in the point detector, and in Models 5G and 5H through contacts in the biased-neutral controller.

The point detector has knife-edged contacts which exert extra-heavy pressure. The Model 5A has three normal, three reverse, and two shunt contacts; Models 5E, 5F, 5G and 5H have two normal, two reverse, two motor control, and two shunt contacts. The motor control contacts in Models 5E and 5F carry and break the motor current directly. Only the 5A switch machine lacks a magnetic detent as it is designed to be energized from an interlocking machine at all



MODEL REFERENCE CHART

MODEL	DUAL CONTROL	BUILT-IN CONTROLLER
5A	NO	NO
5E	NO	NO
5F	YES	NO
5G	NO	YES 10/24 vdc
5H	YES	YES 10/24 vdc

Machines provided with 110 d-c motors can be operated from 110 a-c through rectifiers external to the machine.

times. The Model 5A contains an electromagnetically-operated pole changer.

Models 5E, 5F, 5G and 5H are frost protected by 110-volt heaters located in the motor, controller, and contact compartments. If the installed heaters are not used, a frost shield and felt commutator cover should be installed in the motor. These items are available in a modification kit which is listed later under "Ordering Information."

POWER OPERATION

To move switch points, the motor drives the intermediate gear train and the main gear. The lower end of the stud in the main gear of the Models 5A, 5E, and 5G machines engages the cam bar. On the Models 5F and 5H machines, the lower end of the crank pin in the main splined crank engages the cam bar. As the main gear rotates from either extreme position, it pushes the cam bar toward the wire entrance end of the machine. This moves the dog on the cam bar out of the notch in the lock rod, unlocking the switch points and simultaneously causing the two rollers on the point detector yoke to be centered in the lock dog. Thus, the point detector yoke is moved to the vertical position to open the normal and reverse contacts and to close the motor control contacts. Continued rotation of the main gear causes the roller bearing to move the throw bar six inches. The throw bar moves the switch points which, in turn, move the lock and detector rods.

When the switch points close in the opposite position, the point detector rod is in position so that the point detector yoke and the attached contact block are forced by spring pressure to close the opposite indication contacts. This occurs during the last stage of the cam bar movement, when the bar is withdrawn from the detector yoke rollers and simultaneously locks the lock rod in position.

MANUAL OPERATION

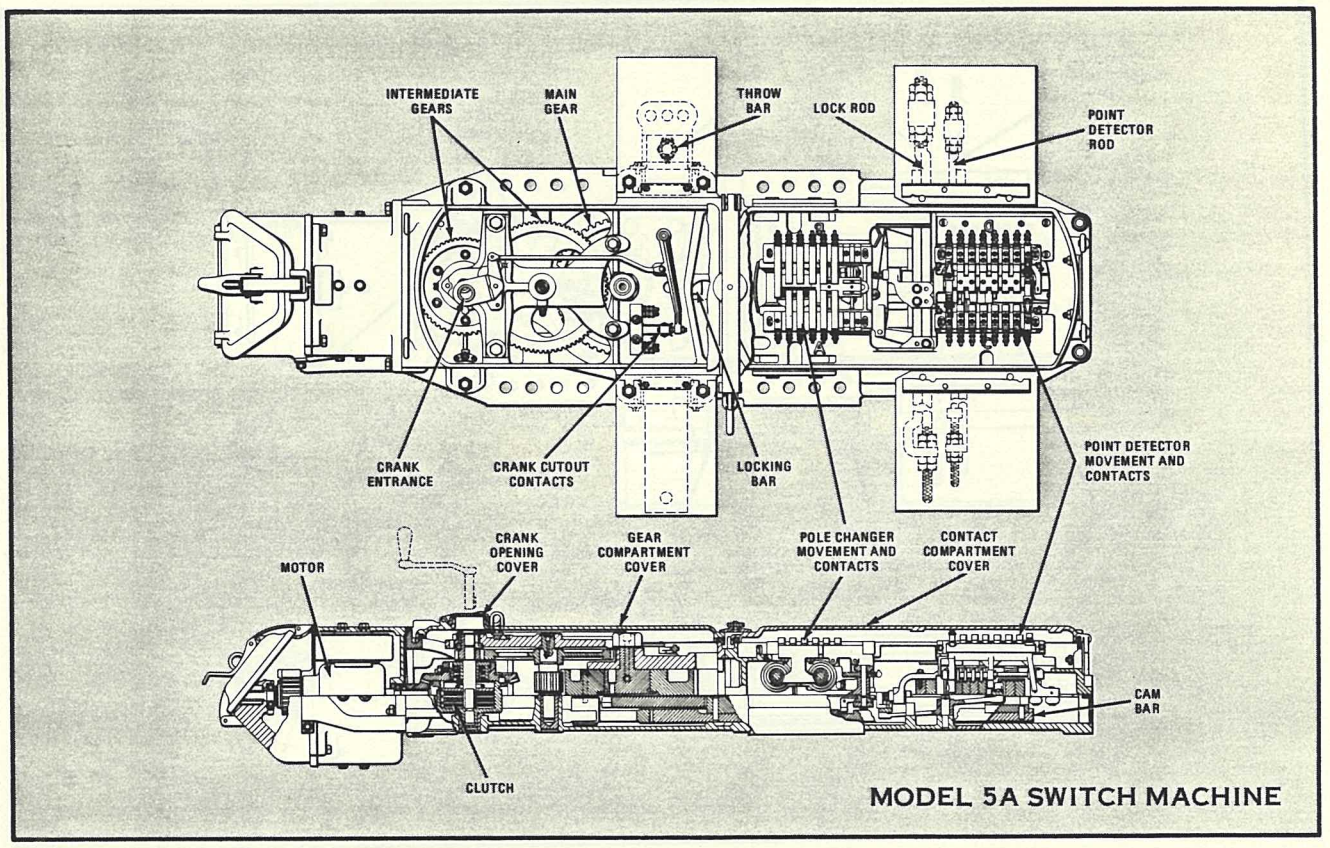
On Models 5F and 5H with dual-control, the selector lever contacts on the dual-control mechanism open the motor and repeater relay circuits when the manually-operated selector lever is moved from the POWER to the HAND position.

During hand-throw operation, cam bar movement forces the rollers on the point detector yoke to be centered in the lock dog. Thus, the point detector yoke is moved to the vertical position to open the detector contacts. The normal and reverse detector contacts do not reclose until the selector lever is returned to the POWER position and the machine, under power operation, locks into the called-for switch position.

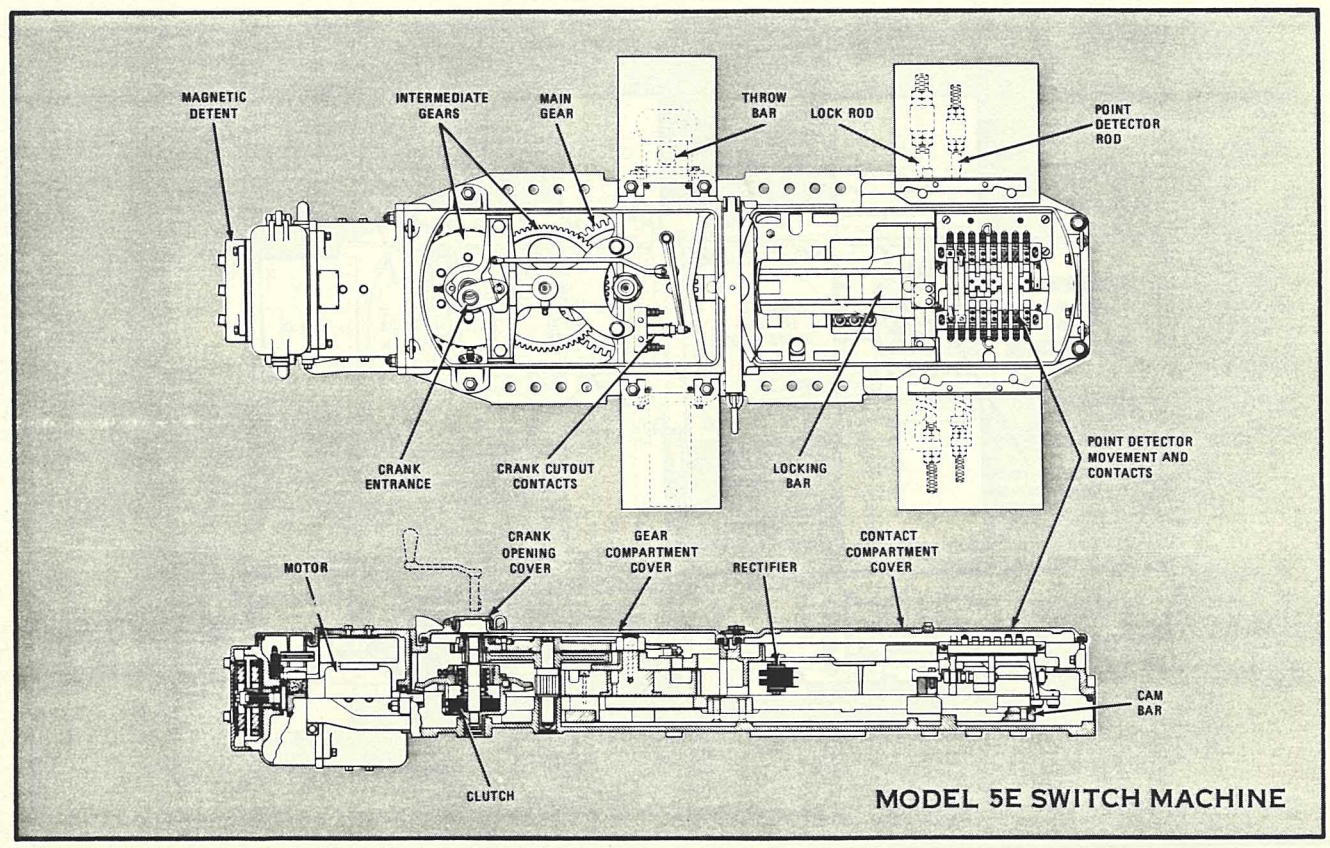
INSTALLATION

Installation and adjustment of the switch machines are relatively straightforward. Its versatility permits a number of configurations, some of which can be changed in the field.

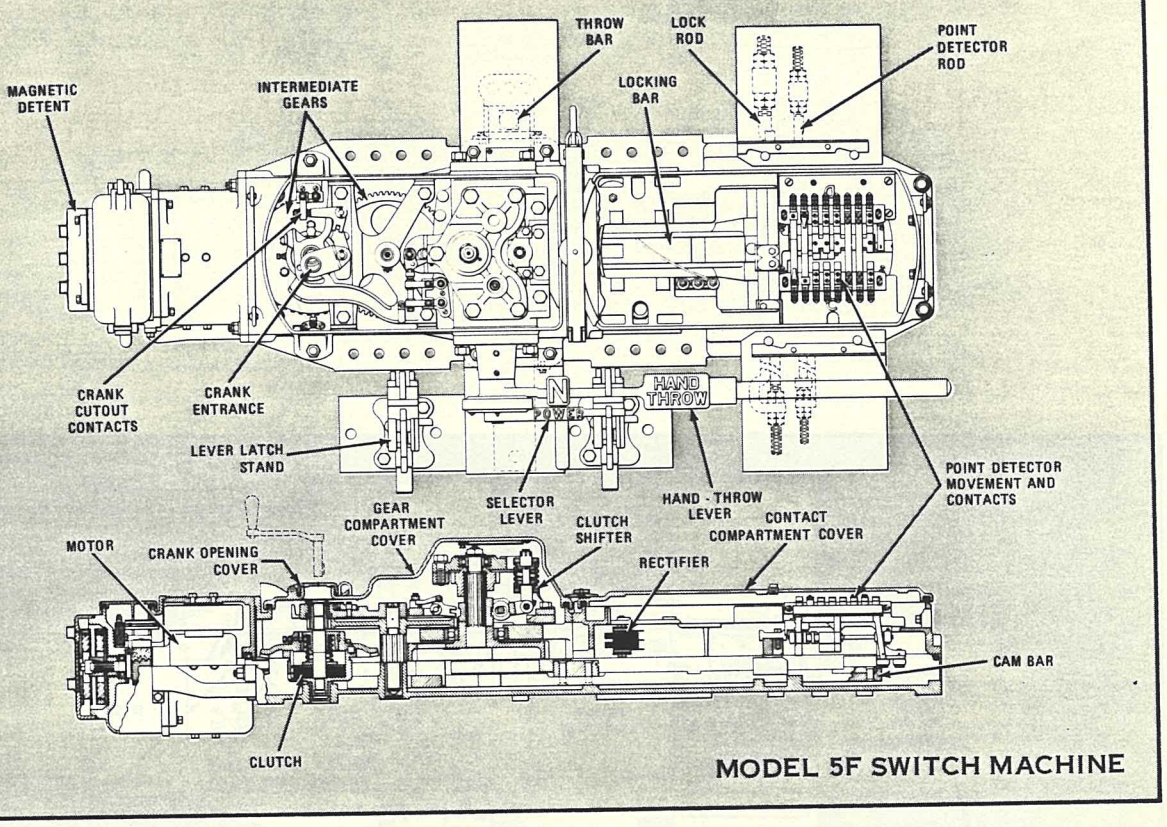
A right-hand machine is one located on the right-hand side of the track when the observer faces the switch points. Power-only machines, Models 5A, 5E, and 5G, ordered with one lock rod and one point detector rod, are shipped in the right-hand configuration only. These can be easily altered in the field to left-hand by reversing the lock rod and point detector rod in the machine and by moving the throw bar connection to the opposite end. Since changeover is more complex, the Model 5A for a movable point frog and Models 5F and 5H dual-control machines may be ordered in either right- or left-hand configurations. Complete operation, installation, and maintenance data are contained in Pamphlet 1559 for the Model 5A machine and Pamphlet 1293 for the Models 5E, 5F, 5G and 5H machines.



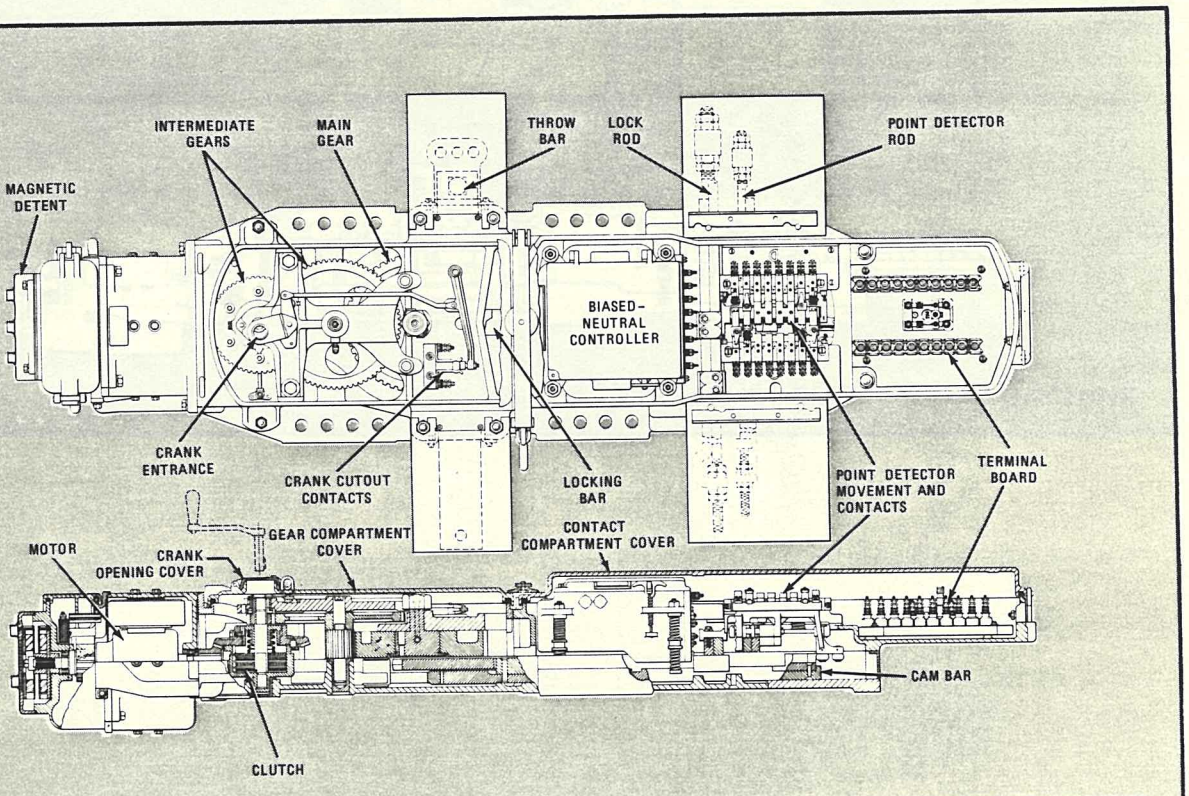
MODEL 5A SWITCH MACHINE



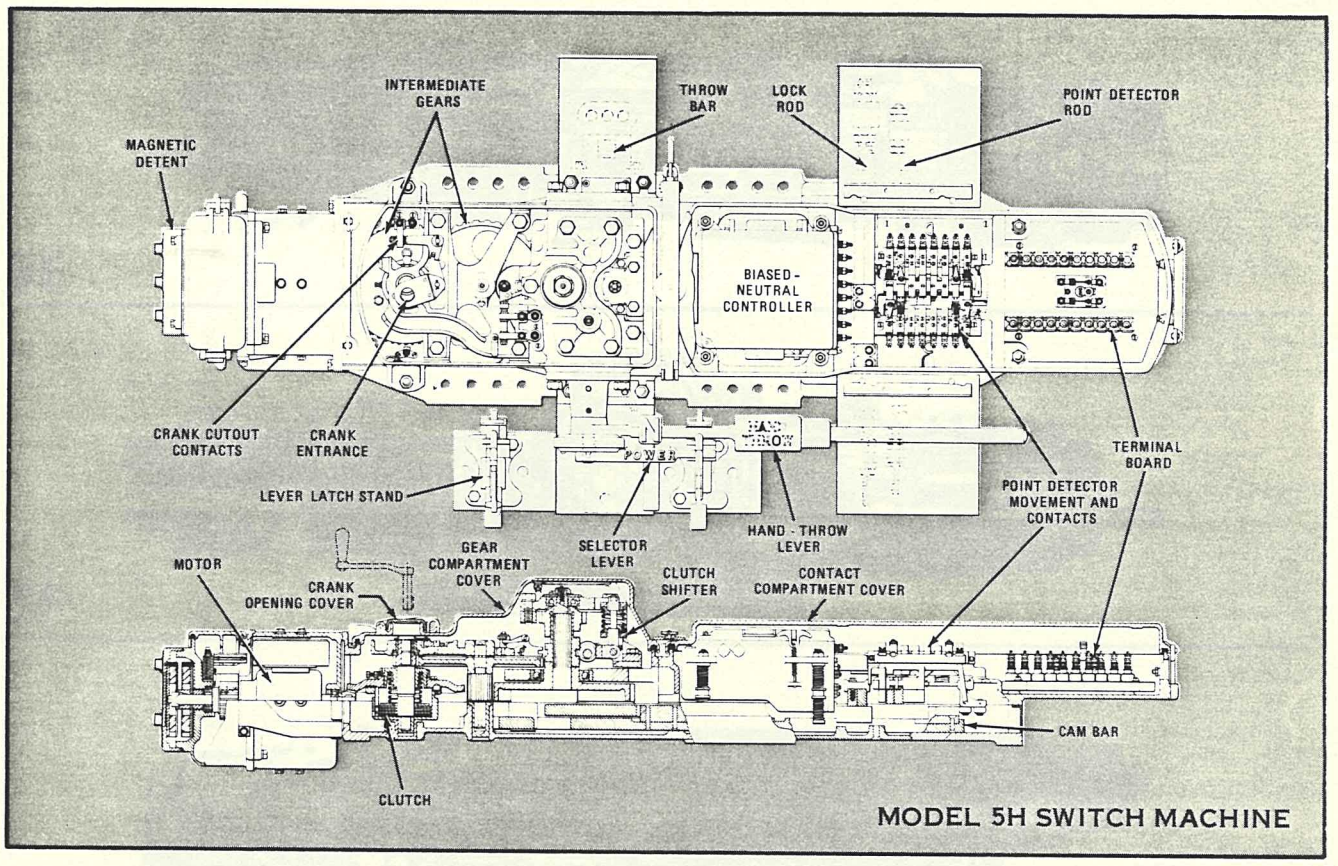
MODEL 5E SWITCH MACHINE



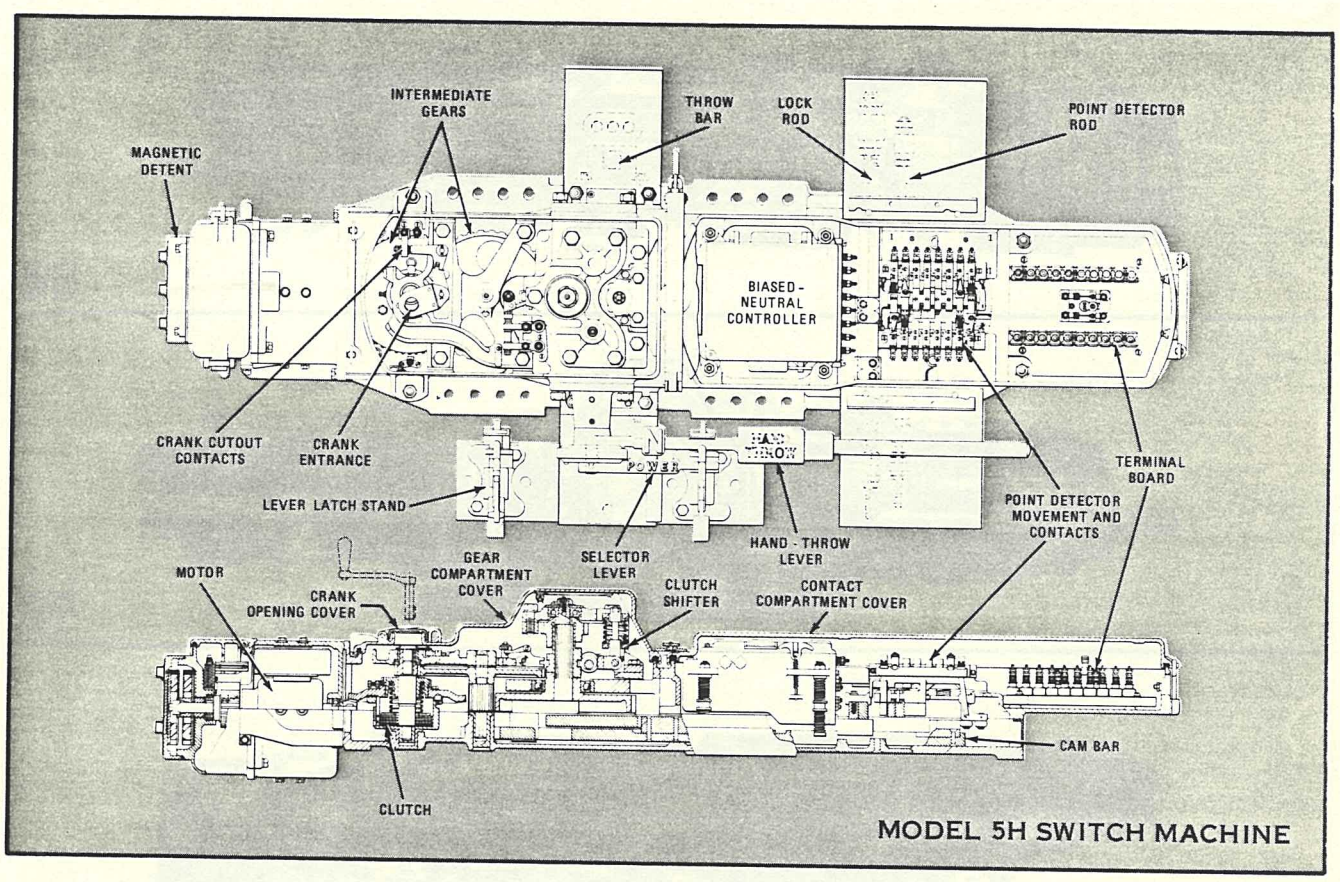
MODEL 5F SWITCH MACHINE



MODEL 5G SWITCH MACHINE

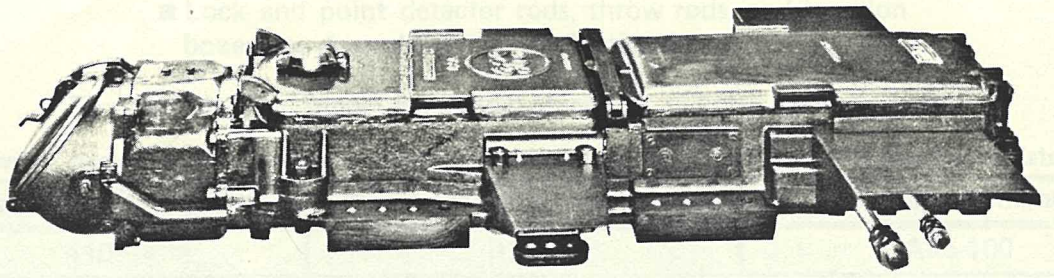


MODEL 5H SWITCH MACHINE

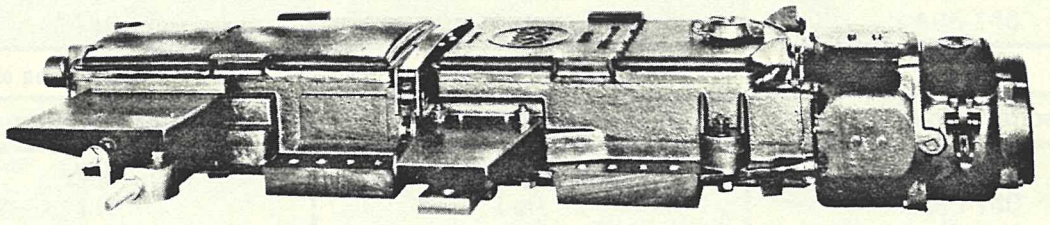


MODEL 5H SWITCH MACHINE

MODEL 5 SERIES SWITCH MACHINES



5A



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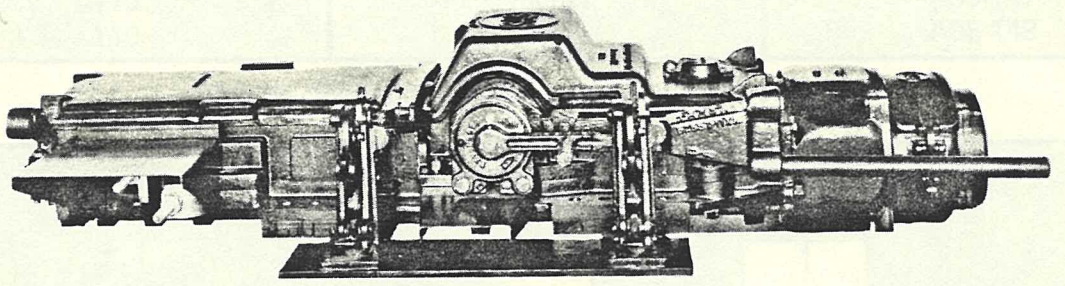

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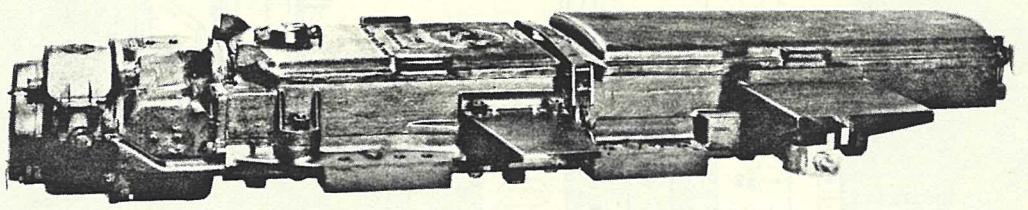
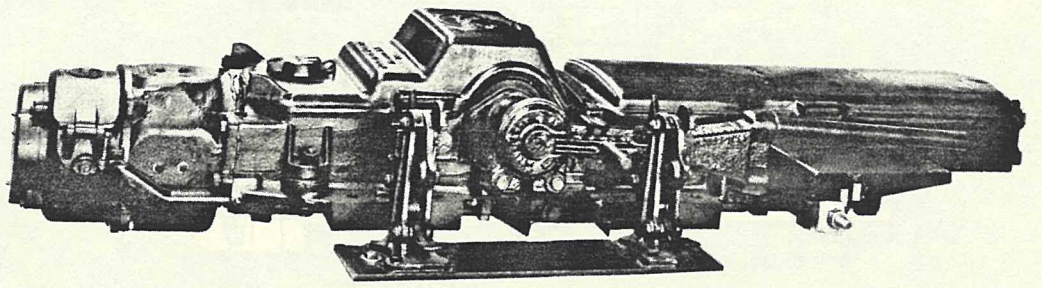


5G



5H

MODEL 5A SWITCH MACHINE

The Model 5A DOES NOT INCLUDE the following; please order separately:

- Accessories; see pages 15, 16, and 17.
- Lock and point detector rods, throw rods, and junction boxes; see Assemblies Catalog Section 91.

To order, specify "Model 5A Switch Machine" and give catalog number.

For single switch; single-slip switch; derail; or double-slip switch with machine having 1 lock and 1 point detector rod:

Operating Voltage D-c	Right or Left Hand	Catalog Number
110	Right*	A85-100

Same as above, except have throw-bar detection switch:

110	Right	A85-145
110	Left	A85-146

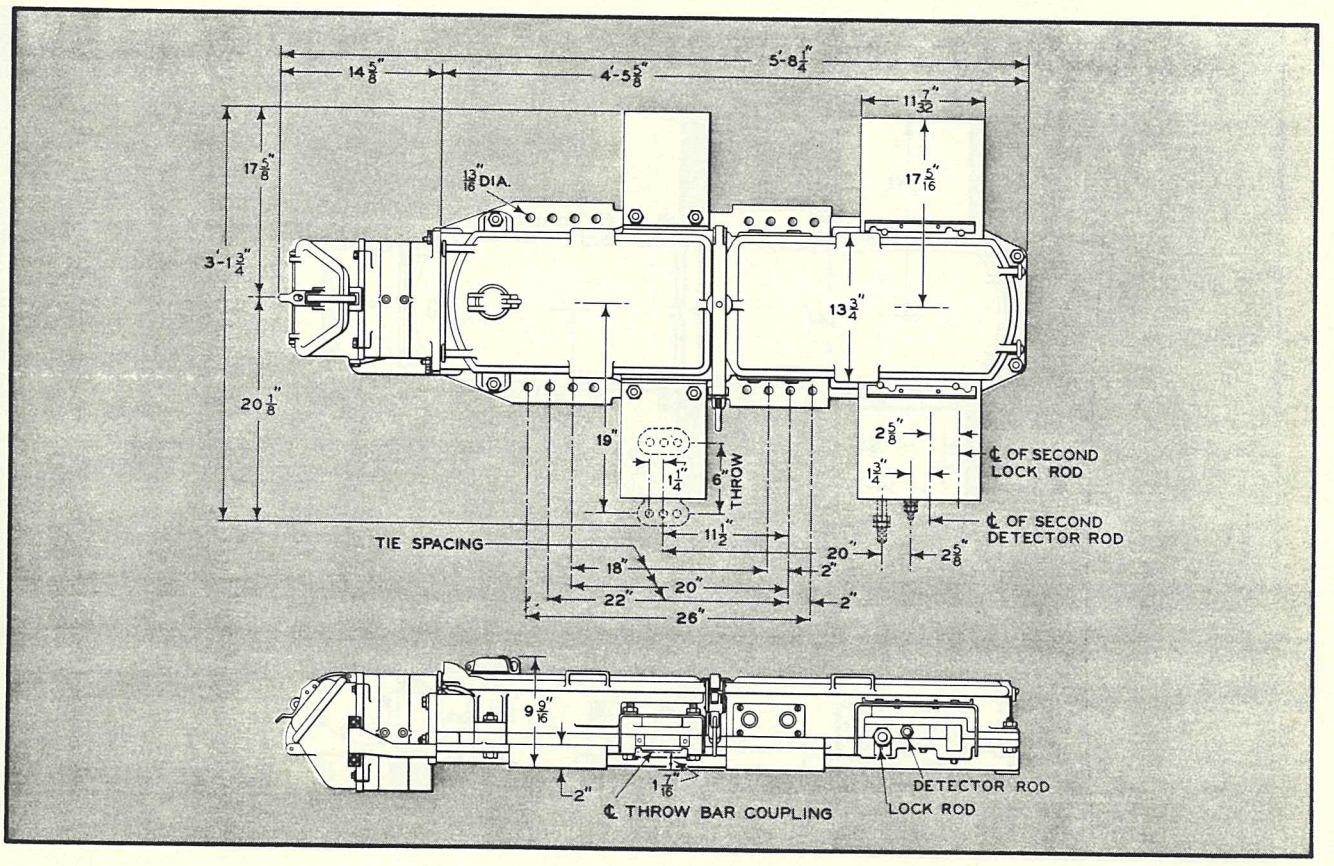
For movable point frog:

Operating Voltage D-c	Right or Left Hand	Catalog Number
110	Right	A85-130
110	Left	A85-140

Same as above, except have throw-bar detection switch:

110	Right	A85-147
110	Left	A85-148

*Can be changed to left-hand layout in field; see page 4.



MODEL 5A SWITCH MACHINE

The Model 5A DOES NOT INCLUDE the following; please order separately:

- Accessories; see pages 15, 16, and 17.
- Lock and point detector rods, throw rods, and junction boxes; see Assemblies Catalog Section 91.

To order, specify "Model 5A Switch Machine" and give catalog number.

For single switch; single-slip switch; derail; or double-slip switch with machine having 1 lock and 1 point detector rod:

Operating Voltage D-c	Right or Left Hand	Catalog Number
110	Right*	A85-100

Same as above, except have throw-bar detection switch:

110	Right	A85-145
110	Left	A85-146

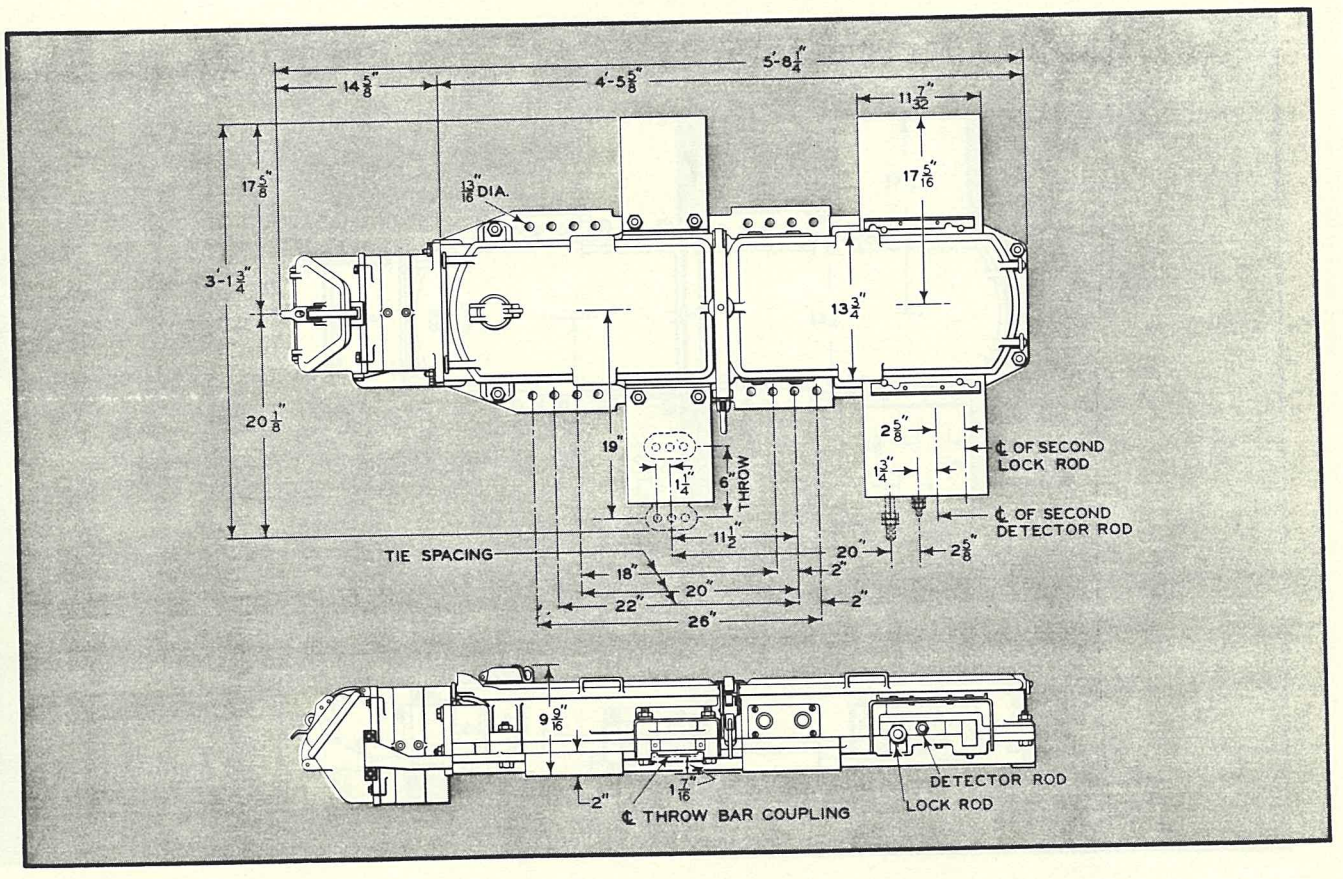
For movable point frog:

Operating Voltage D-c	Right or Left Hand	Catalog Number
110	Right	A85-130
110	Left	A85-140

Same as above, except have throw-bar detection switch:

110	Right	A85-147
110	Left	A85-148

*Can be changed to left-hand layout in field; see page 4.



MODEL 5E SWITCH MACHINE

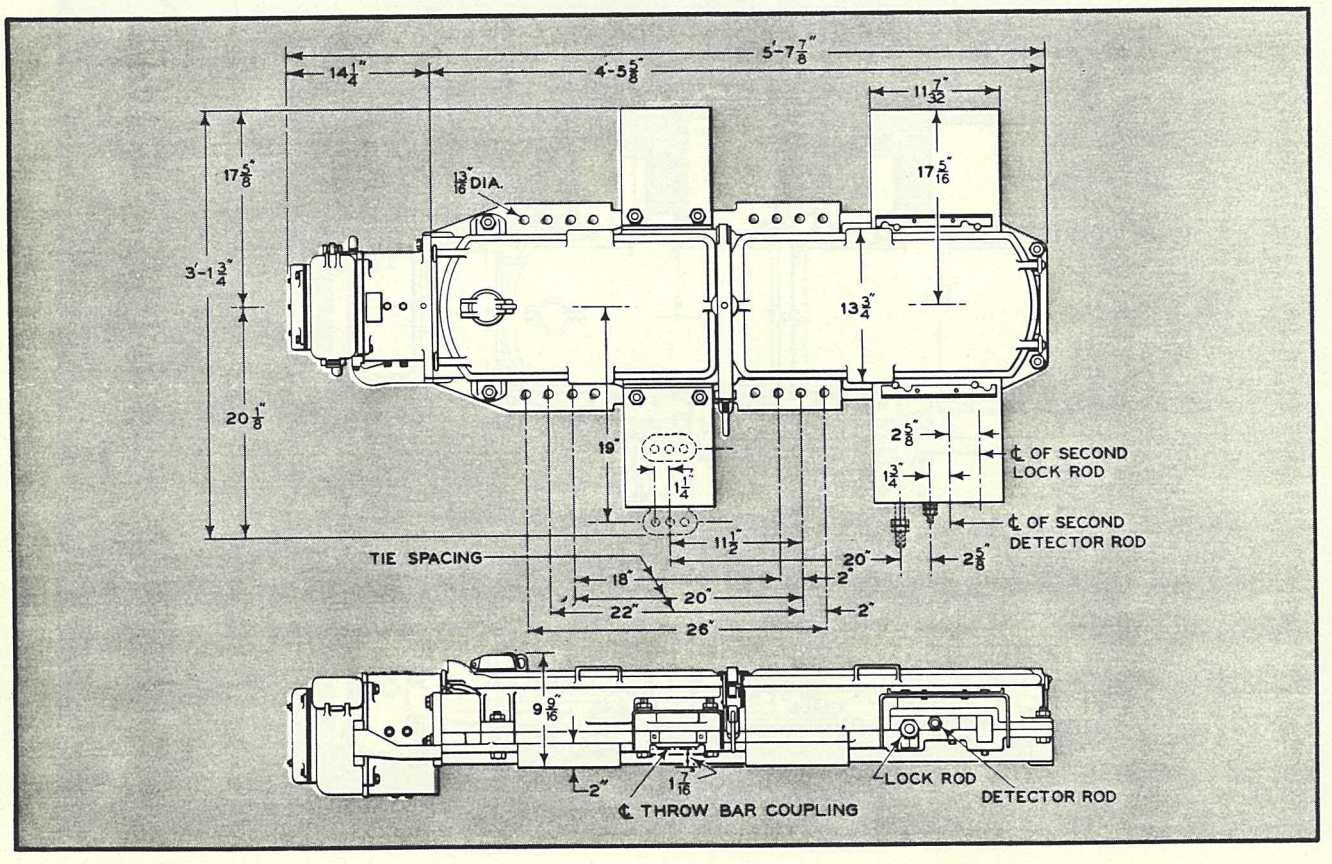
The Model 5E DOES NOT INCLUDE the following; please order separately:

- Accessories; see pages 15, 16, and 17.
- Type B or Type K switch control and switch overload relays; see Assemblies Catalog Sections 62 and 65.
- Lock and point detector connecting rods, throw rods, and junction boxes; see Assemblies Catalog Section 91.

To order, specify "Model 5E Switch Machine" and give catalog number.

Operating Voltage D-c	Right or Left Hand	Catalog Number
110	Right Only*	A85-151
24	Right Only*	A85-153

*Can be changed to left-hand layout in field; see page 4.



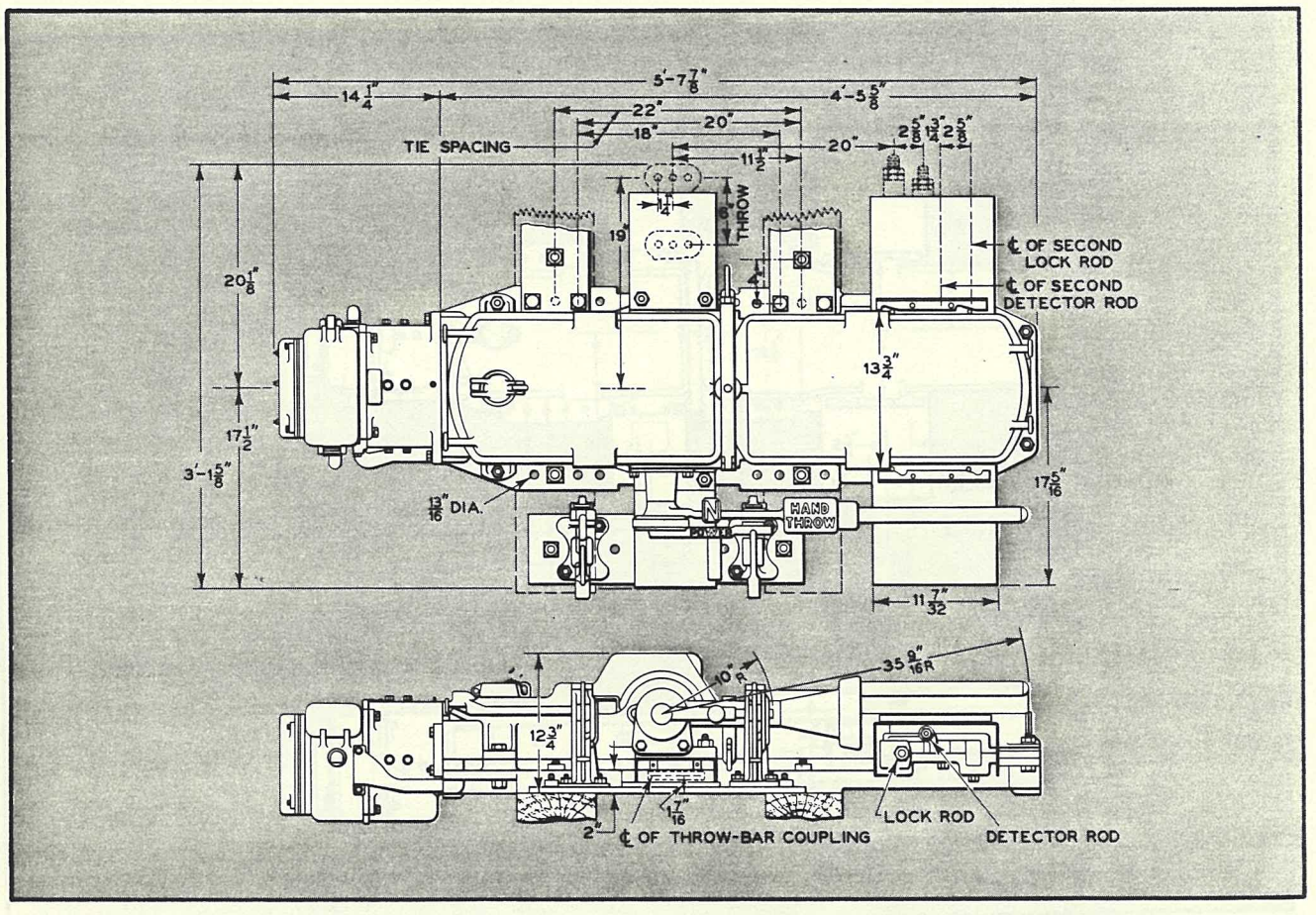
MODEL 5F DUAL CONTROL SWITCH MACHINE

The Model 5F DOES NOT INCLUDE the following; please order separately:

- Accessories; see pages 15, 16, and 17.
- Type B or Type K switch control and switch overload relays; see Assemblies Catalog Sections 62 and 65.
- Lock and point detector connecting rods, throw rods, and junction boxes; see Assemblies Catalog Section 91.

To order, specify "Model 5F Switch Machine" and give catalog number.

Operating Voltage D-c	Right or Left Hand	Catalog Number
110	Right	A85-201
110	Left	A85-203
24	Right	A85-206
24	Left	A85-208



MODEL 5G SWITCH MACHINE

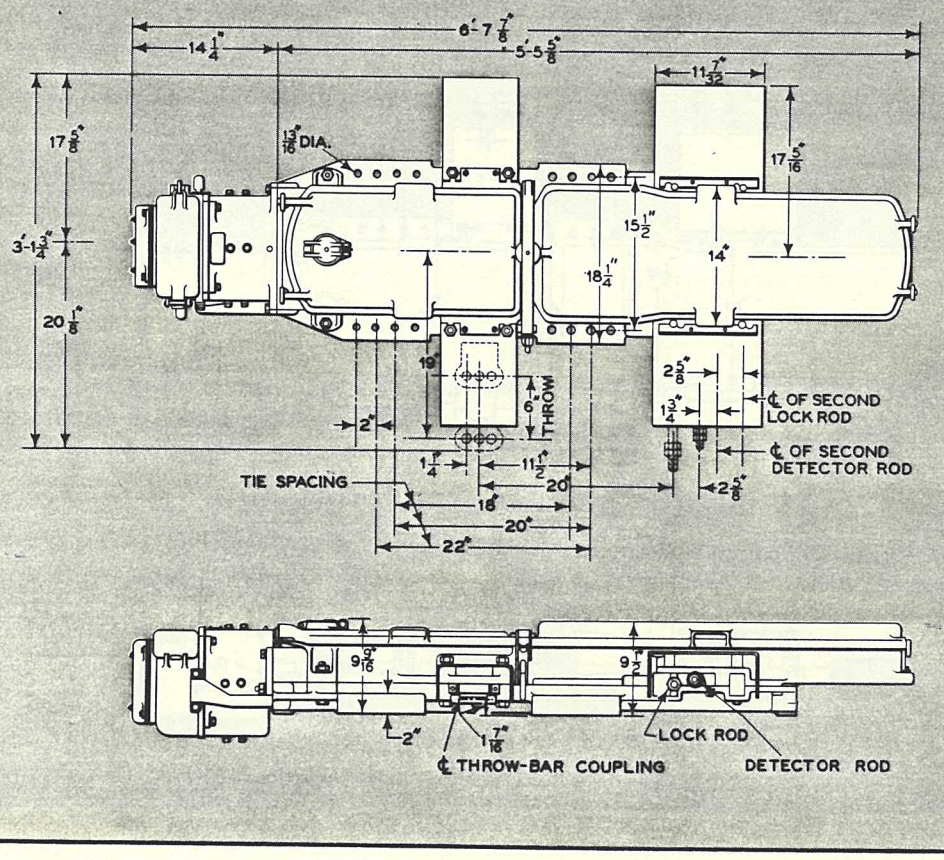
The Model 5G DOES NOT INCLUDE the following; please order separately:

- Accessories; see pages 15, 16, and 17.
- Lock and point detector connecting rods, throw rods, and junction boxes; see Assemblies Catalog Section 91.

To order, specify "Model 5G Switch Machine" and give catalog number.

Operating Voltage D-c	Control Voltage D-c	Right or Left Hand	Catalog Number
110	10 or 24	Right Only*	A85-247
24	10 or 24	Right Only*	A85-251

*Can be changed to left-hand layout in field; see page 4.



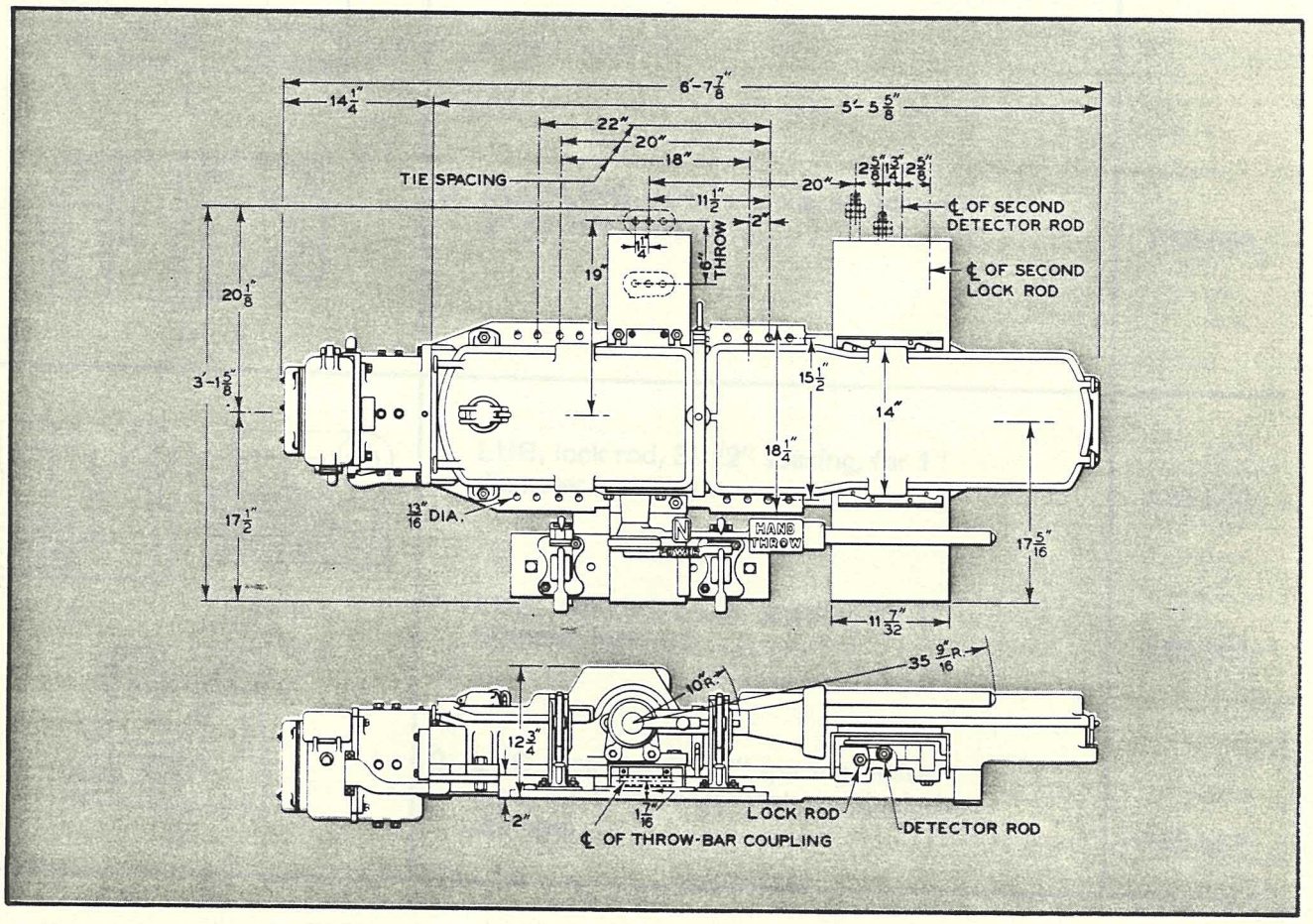
MODEL 5H DUAL CONTROL SWITCH MACHINE

The Model 5H DOES NOT INCLUDE the following; please order separately:

- Accessories; see pages 15, 16, and 17.
- Lock and point detector connecting rods, throw rods, and junction boxes; see Assemblies Catalog Section 91.

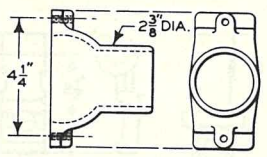
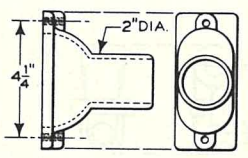
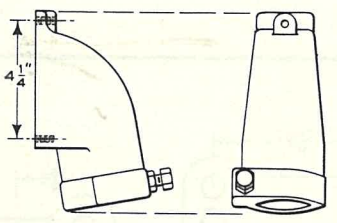
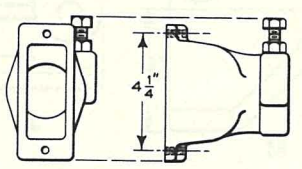
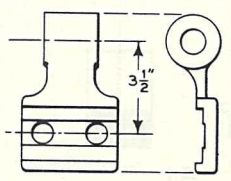
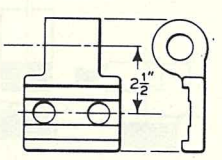
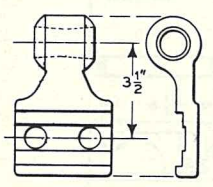
To order, specify "Model 5H Switch Machine" and give catalog number.

Operating Voltage D-c	Control Voltage D-c	Right or Left Hand	Catalog Number
110	10 or 24	Right	A85-302
110		Left	A85-304
24	10 or 24	Right	A85-312
24		Left	A85-314



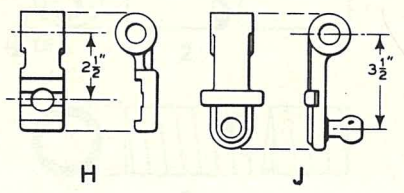
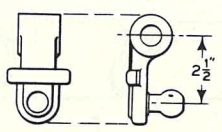
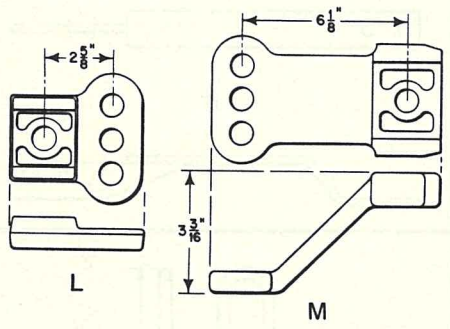
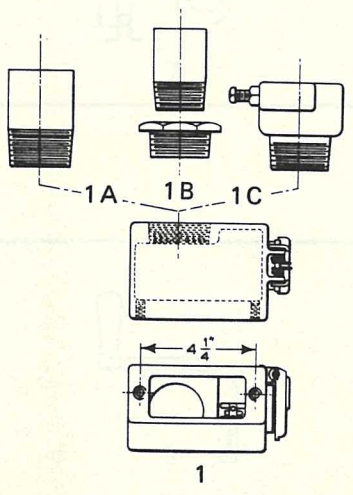
ACCESSORIES

PLEASE ORDER BY CATALOG NUMBER AND NAME SHOWN IN BOLD TYPE

REFERENCE	NAME	CATALOG NUMBER
 A	**A. COUPLING,** wire entrance, for 2-3/8" I. D. split or solid rubber conduit	**A85-500**
 B	**B. COUPLING,** wire entrance, for 1-7/8" I.D. split or solid rubber conduit	**A85-501**
 C	**C. COUPLING,** wire entrance, offset, for 2" flexible conduit	**A85-502**
 D	**D. COUPLING,** wire entrance, straight, for 2" flexible conduit	**A85-503**
 E	**E. LUG,** lock rod, 3-1/2" spacing, for 1" diameter lock rod	**A85-560**
 F	**F. LUG,** lock rod, 2-1/2" spacing, for 1" diameter lock rod	**A85-561**
 G	**G. LUG,** lock rod, 3-1/2" spacing, swivel type, for 1" diameter lock rod, includes cap nuts	**A85-562**

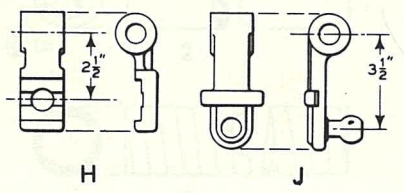
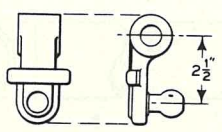
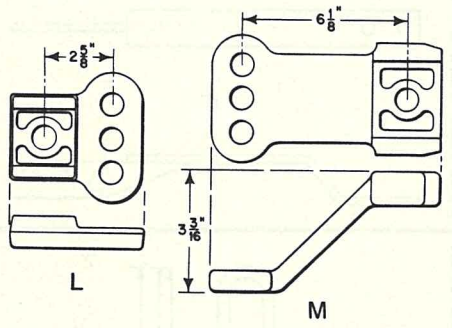
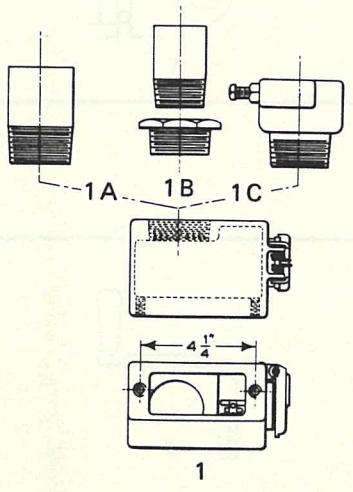
ACCESSORIES (cont'd)

PLEASE ORDER BY CATALOG NUMBER AND NAME SHOWN IN BOLD TYPE

REFERENCE	NAME	CATALOG NUMBER
 H J	**H. LUG,** detector rod, 2-1/2" spacing, for 3/4" diameter rod, noninsulated	**A85-563**
	J. LUG, detector rod, 3-1/2" spacing, for 3/4" diameter detector rod, noninsulated, needs grease fitting, reference 5 . .	**A85-564**
 K	**K. LUG,** detector rod, 2-1/2" spacing, for 3/4" diameter detector rod, noninsulated, needs grease fitting, reference 5 . .	**A85-565**
	K1. LUG, same as K above except insulated	**A85-566**
	K2. LUG, same as K above except insulated and for 1" diameter detector rod	**A85-567**
 L M	**L. COUPLING,** throw bar	**P85-709**
	M. COUPLING, offset for throw bar	**P85-925**
 1	**1. WIRE ENTRANCE COUPLING,** with telephone jack, mounted in case, no conduit fittings	**A85-510**
	1A. As above, except with fitting for 2-3/8" I. D. rubber conduit	**A85-511**
	1B. Same as Ref. 1, except with fitting for 1-7/8" I.D. rubber conduit	**A85-512**
	1C. Same as Ref. 1, except with fitting for 2" flexible conduit	**A85-513**

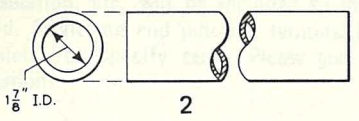
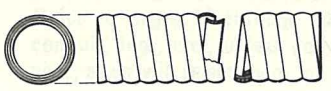
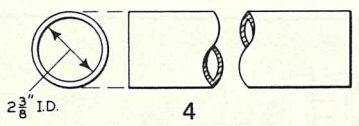
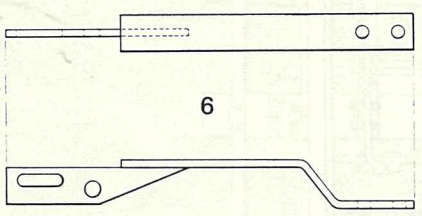
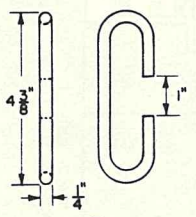
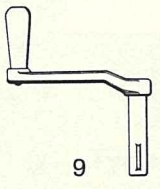
ACCESSORIES (cont'd)

PLEASE ORDER BY CATALOG NUMBER AND NAME SHOWN IN BOLD TYPE

REFERENCE	NAME	CATALOG NUMBER
 H J	**H. LUG,** detector rod, 2-1/2" spacing, for 3/4" diameter rod, noninsulated	**A85-563**
	J. LUG, detector rod, 3-1/2" spacing, for 3/4" diameter detector rod, noninsulated, needs grease fitting, reference 5 . .	**A85-564**
 K	**K. LUG,** detector rod, 2-1/2" spacing, for 3/4" diameter detector rod, noninsulated, needs grease fitting, reference 5 . .	**A85-565**
	K1. LUG, same as K above except insulated	**A85-566**
	K2. LUG, same as K above except insulated and for 1" diameter detector rod	**A85-567**
 L M	**L. COUPLING,** throw bar	**P85-709**
	M. COUPLING, offset for throw bar	**P85-925**
 1	**1. WIRE ENTRANCE COUPLING,** with telephone jack, mounted in case, no conduit fittings	**A85-510**
	1A. As above, except with fitting for 2-3/8" I. D. rubber conduit	**A85-511**
	1B. Same as Ref. 1, except with fitting for 1-7/8" I.D. rubber conduit	**A85-512**
	1C. Same as Ref. 1, except with fitting for 2" flexible conduit	**A85-513**

ACCESSORIES (cont'd)

PLEASE ORDER BY CATALOG NUMBER AND NAME SHOWN IN BOLD TYPE

REFERENCE	NAME	CATALOG NUMBER
 2	**2. CONDUIT,** 1-7/8" I. D., solid rubber, recommended length 3' -- specify number of feet required	A85-520
 3	**3. CONDUIT,** 2" flexible, recommended length 3' --specify number of feet required	A85-530
 4	**4. CONDUIT,** 2-3/8" I. D., solid rubber, recommended length 3' -- specify number of feet required	A85-535
5	**5. GREASE FITTING,** for detector rod lugs.	P87-101
 6	**6. TEST BAR,** provides means to check operation of machine and circuits before connecting machine to switch	P85-1357
 7	**7. GAUGE,** for adjustment of point detector rod without releasing lock rod.	P85-1216
	8. MODIFICATION KIT, frost shield and felt commutator cover for the motor, required when heaters will not be used in switch machines	P85-1356
 9	**9. HAND CRANK,** for set-up and emergency operation of switch machine	P85-826

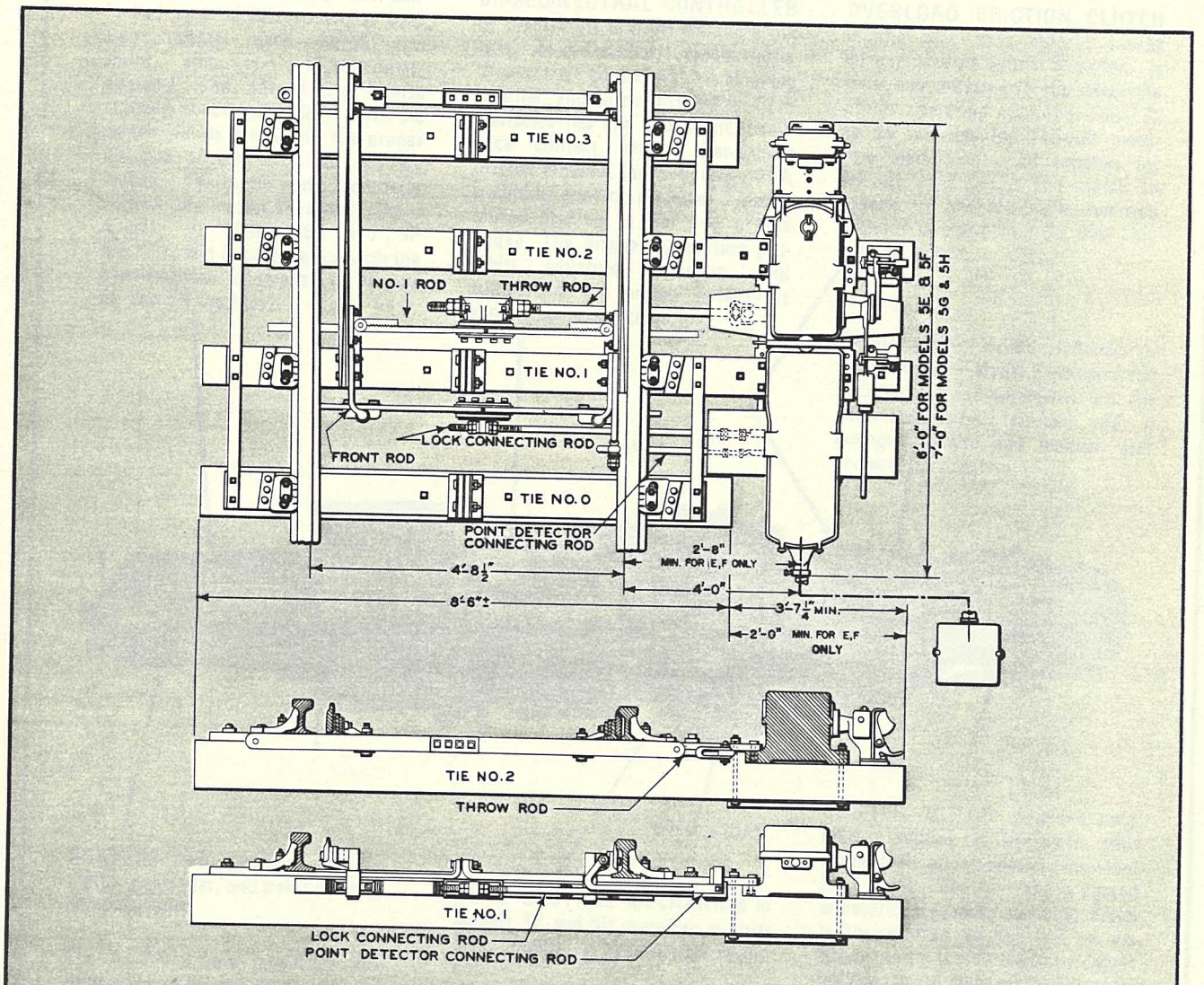
QUESTIONNAIRE

Complete Switch Layout

If you wish, GRS can select all parts for you to make up a complete layout as shown here (but not including: rails, rail fastenings, ties, tie straps, number one rod, or gauge plates). Bolts furnished will be for full length, one inch thick gauge plates, as shown. Also, the necessary connecting plate, bolts, insulation, etc. will be included to insulate your number one rod. Front rod and junction terminal box will not be included unless you specify same. Please give us the following information:

1. Catalog number of Model 5 switch machine you want. Refer to pages 10 through 14. You need not specify conduit, lugs, etc., unless you have a particular preference, as we will select them for you.
2. Characteristics of your number one rod:
   Horizontal: _____ Vertical: _____ Inches thick: _____
3. Distance from centerline of switch machine to gauge of rail: _____
4. Weight of rail: _____
5. Do you wish to include:
   Junction Terminal Box A91-230?
   Yes: _____ No: _____

Front Rod? If so, please select from Catalog Section 91 and state catalog number: _____

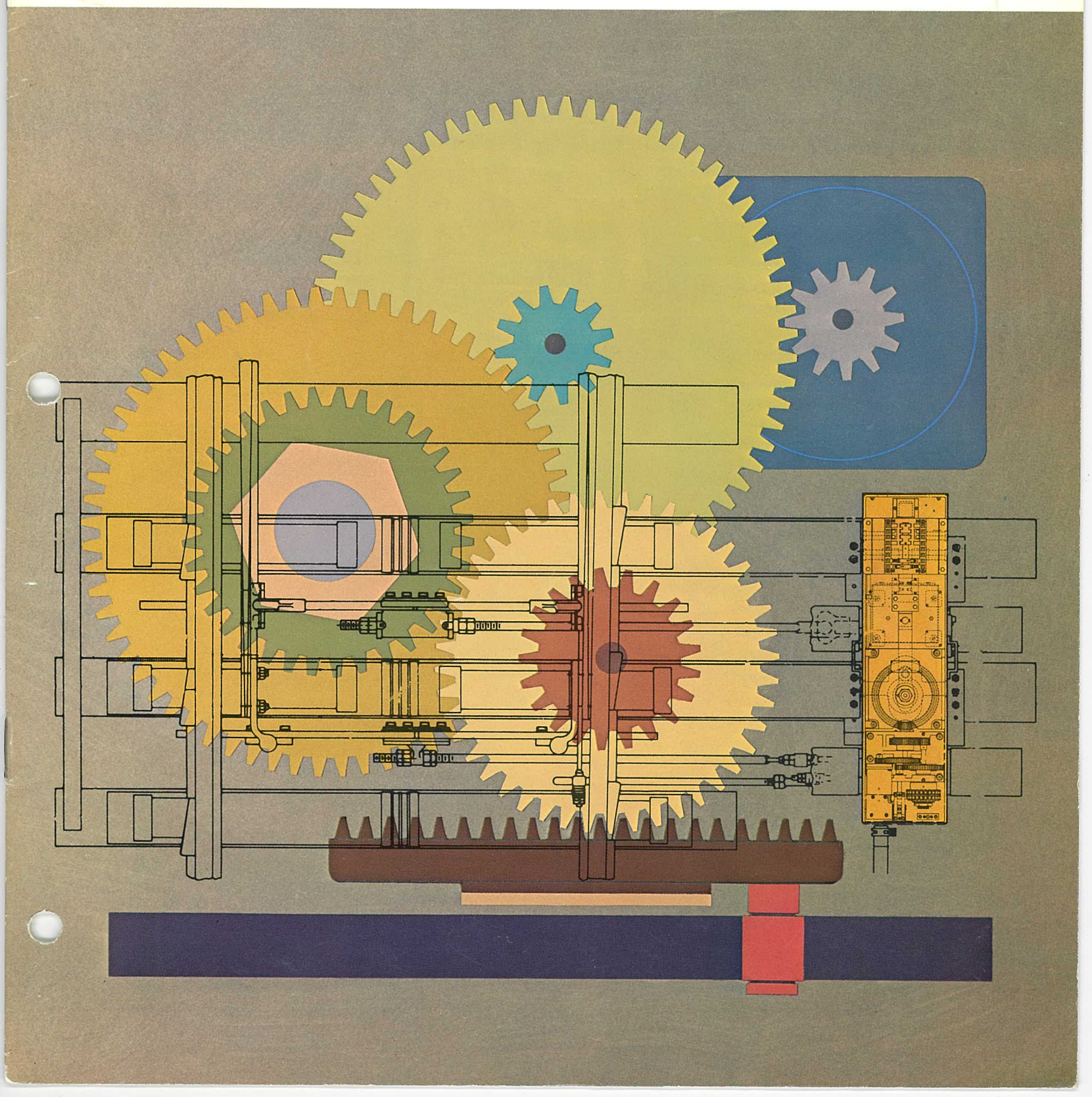


Typical right-hand single-switch layout with GRS hinged front rod.

MODEL 55
ELECTRIC SWITCH MACHINES

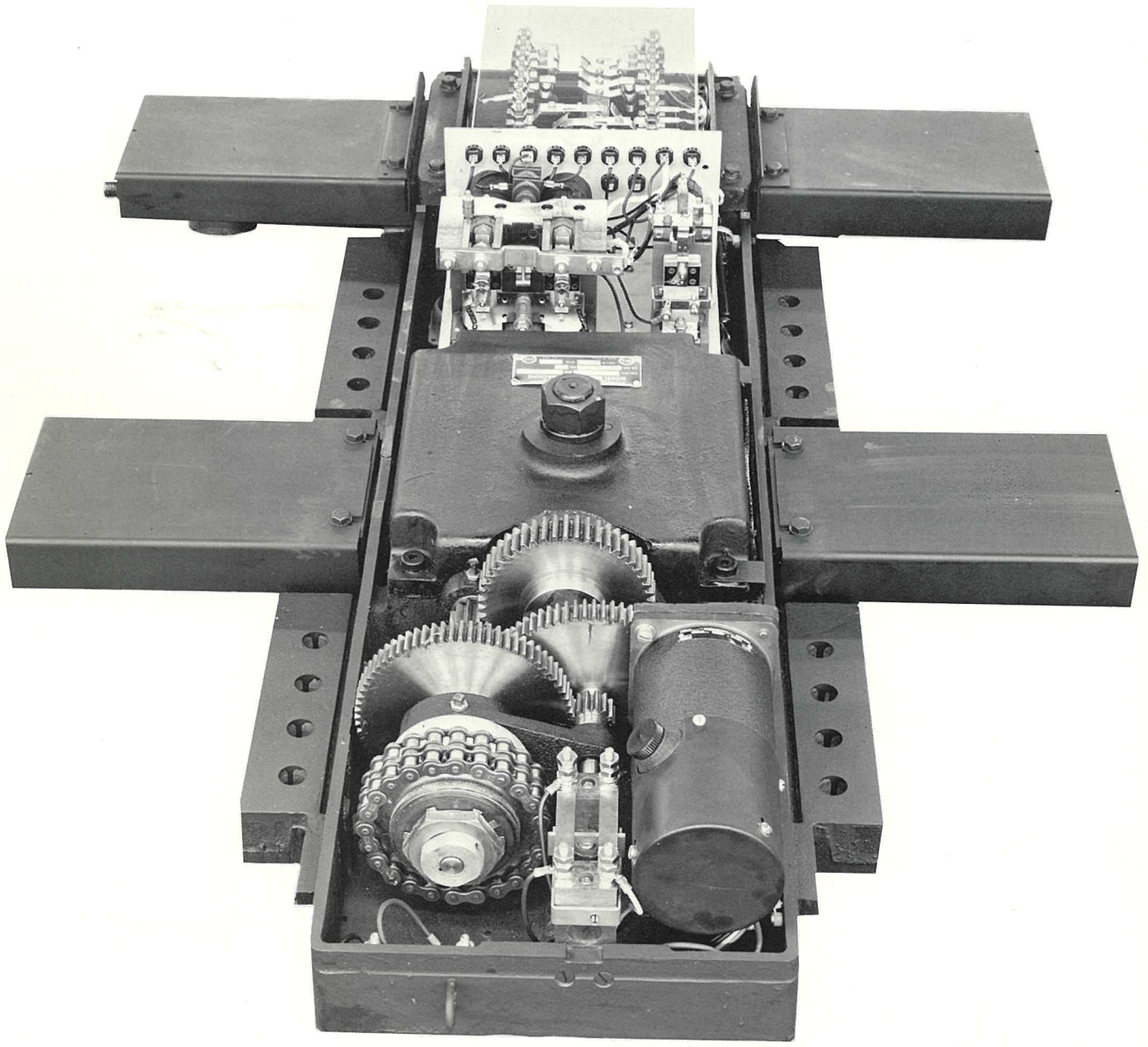
FOR MAINLINE, INTERLOCKING, AND RAPID TRANSIT SERVICE

GRS CATALOG **85-2**



MODEL 55 ELECTRIC SWITCH MACHINES

- Versatile
- Lightweight (500 pounds)
- Easy Installation
- "Easy Access" Design
- Reduced Maintenance
- Unit Construction
- Wide Range of Operating and Control Voltages



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INTRO

The Mod mainline can oper switch, c rod, or a

General I

The Mod 55E and operated detector check the and rever cranked f cranking of power

Control a housed e neutral co wire polar 24- or 110 be easily railroad re battery in motors ca

Operating machines

INTRODUCTION

The Model 55 electric switch machine is for use in mainline, interlocking, and rapid transit service. It can operate either a single switch, single-slip switch, double-slip switch with continuous front rod, or any type derail.

General Description

The Model 55 switch machine is available in two Models: 55E and 55G. It basically consists of an electrically operated switch and lock movement, with lock rod, point detector rod and built-in circuit controller contacts that check the machine over-and-locked in both the normal and reverse positions. The machines can be hand cranked for making and checking adjustments; hand cranking is used for emergency switch operation in case of power failure.

Control and overload relays for the Model 55E are housed externally. The Model 55G has a built-in biased-neutral controller operated by a low-voltage d-c, two-wire polarized line circuit. The controller, in turn, applies 24- or 110-volt d-c to the motor. This control voltage can be easily changed in the field from 24 to 10 volts to suit railroad requirements. Both models are designed for battery indication. Machines provided with 110 d-c motors can be operated from 110 a-c through rectifiers.

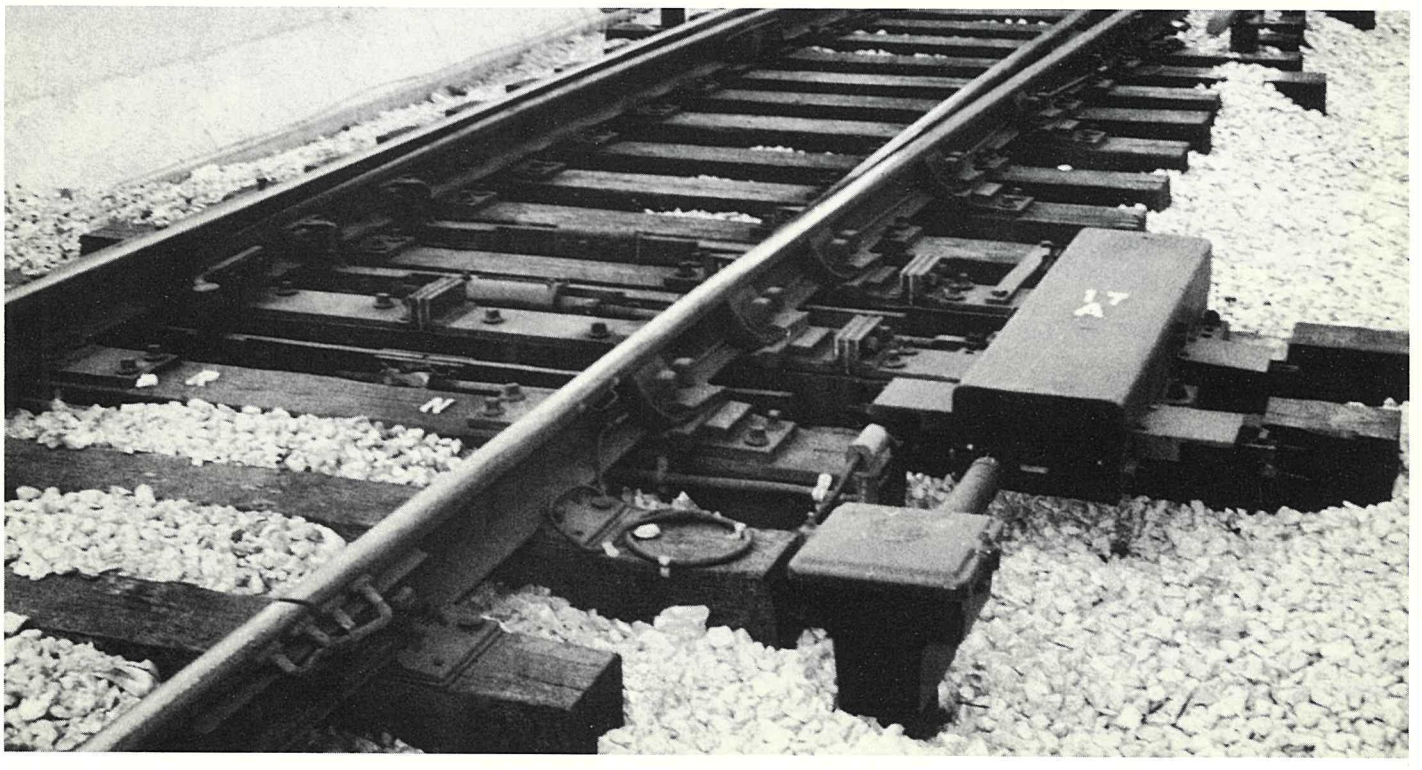
Operating time is approximately 3 seconds for 110-volt machines, and 8 to 10 seconds for 24-volt machines.

A permanent magnet holding device holds the motor after the end of the stroke. The magnetic detent then holds the motor armature against vibration and low-level stray electrical currents.

The point detector has knife-edged contacts which exert extra-heavy pressure to combat frost. There are two normal, two reverse, two motor control, and two shunt contacts. The motor control contacts in the Model 55E carry and break the motor current directly.

The machines are frost protected by 110-volt heaters, located in the motor, controller, and contact compartments, and by a transparent cover mounted over the point detector contacts.

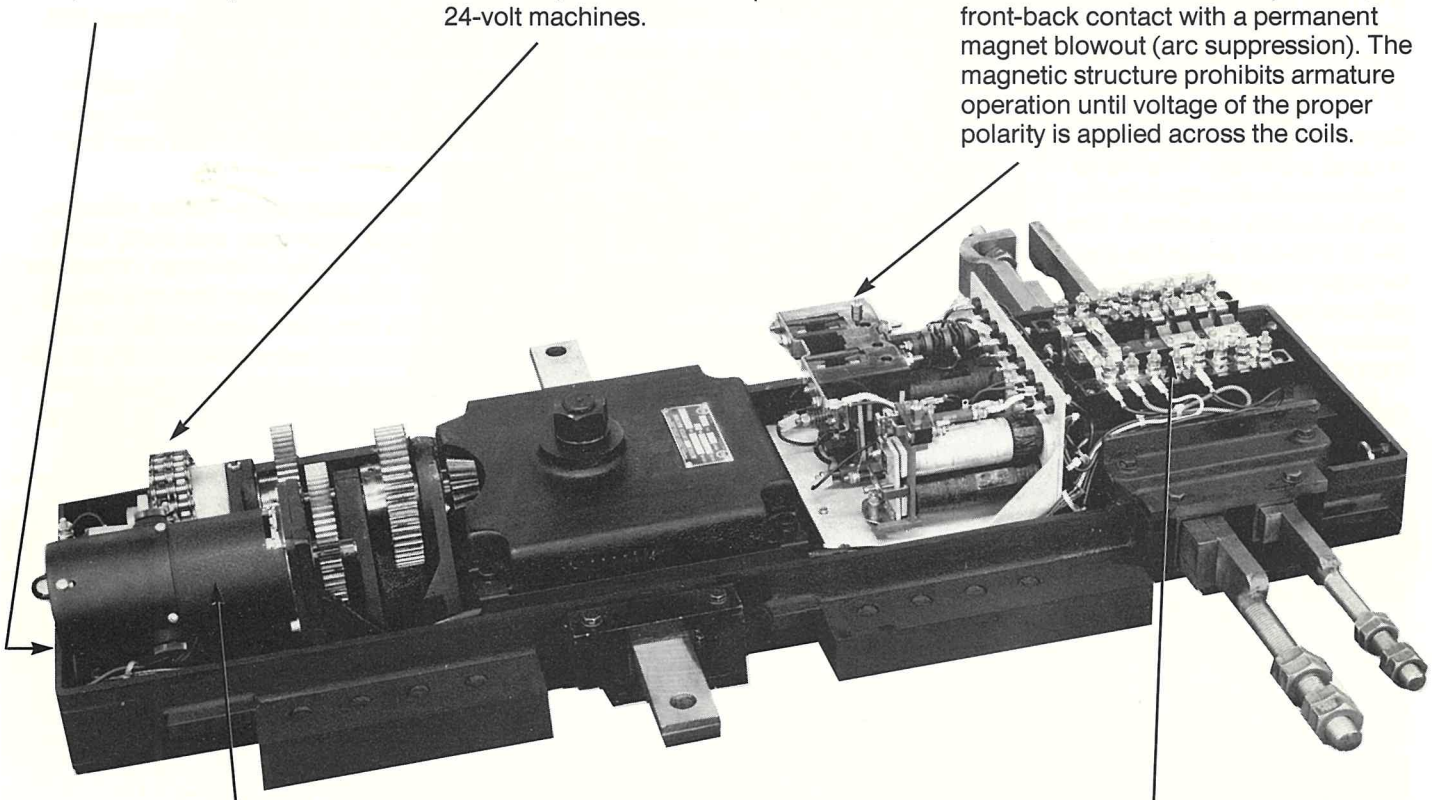
Unit construction of major assemblies—motor, intermediate gear train, and clutch; main gear and shaft; point detector; biased-neutral controller—facilitates inspection and replacement, thus, reducing down time and saving valuable man hours. The one-piece deep-sided cover, when removed, leaves internal assemblies readily accessible for easier maintenance. Special hardware is used at critical points in the assemblies to prevent loosening during periods of vibration.



Removable Hand Crank
is provided on all Model 55 machines for maintenance and emergency use. An automatic cutout contact with a latchout feature and manual reset protects the operator.

Overload Friction Clutch
in the gear train absorbs shocks encountered in switch operation. It is factory adjusted to slip when the motor operating current is from 9 to 11 amperes for 110-volt d-c and a-c machines, and 18 to 20 amperes for 24-volt machines.

Biased-Neutral Controller
in Model 55G machine has two biased-neutral, mechanically interlocked contactors, a blocking rectifier, and an overload relay. A single-phase bridge rectifier is included for a-c operation. Each contactor has one dependent, front-back contact with a permanent magnet blowout (arc suppression). The magnetic structure prohibits armature operation until voltage of the proper polarity is applied across the coils.



Compact Motor
(only 4 inches in diameter) has a series split-connected encapsulated field coils and armature for maximum protection against moisture. A simple magnetic holding device locks the motor armature after the machine completes a stroke. Magnetic holding is frictionless and virtually maintenance free—nothing to wear out.

Heaters
are provided in the motor, controller, and point detector compartments.

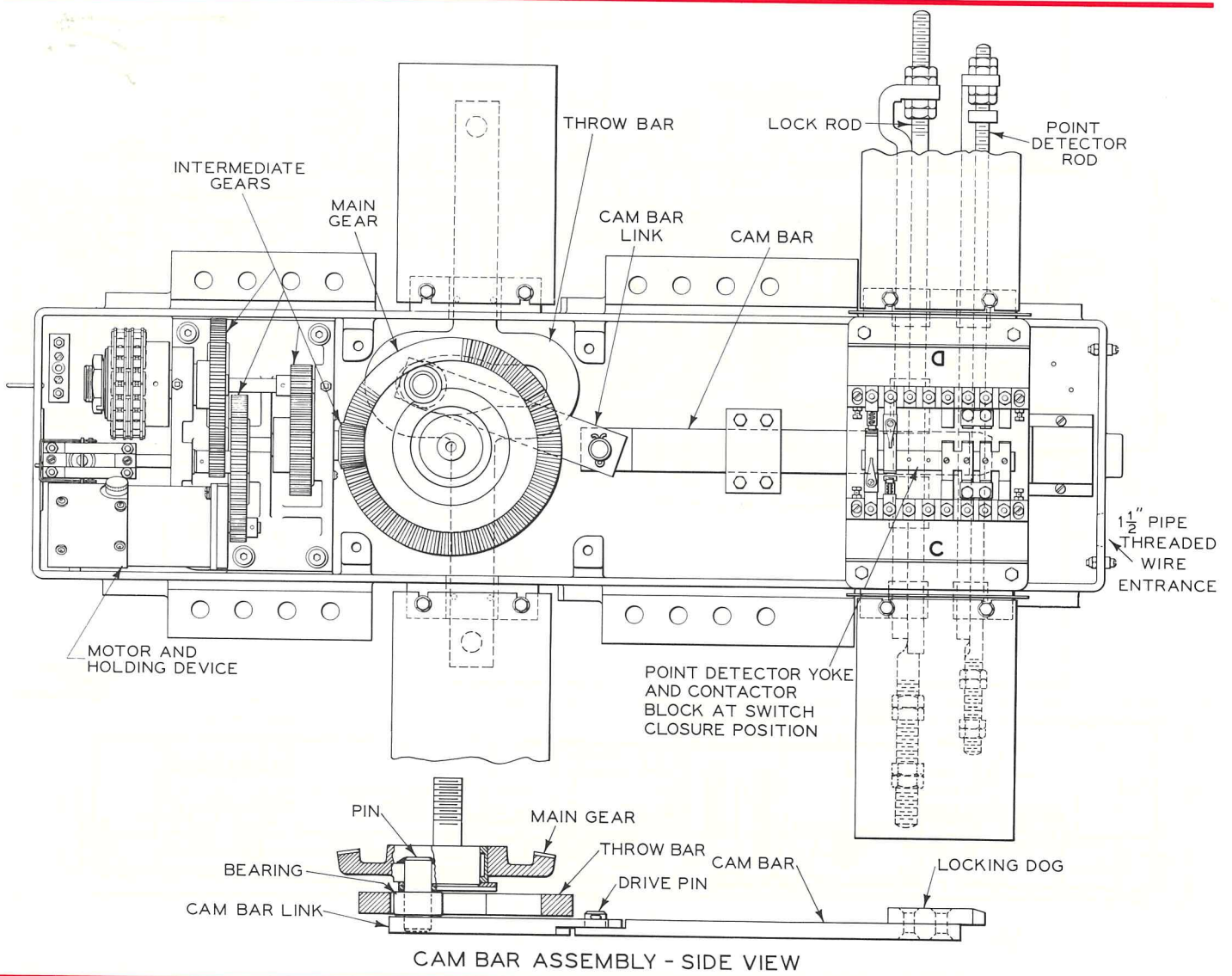
Wear Points
The machines have renewable box style bearings for the throw bar, and wear plates for the lock and detector rods.

Point Detector
is an over-and-locked type circuit controller with two normal, two reverse, two shunt, and two motor-control contacts. The normal and reverse contacts check and indicate when the switch points are within the proper distance of the stock rail and are locked. The motor-control contacts control the motor-operating circuit directly in the Model 55E machine and in conjunction with the biased-neutral controller in the Model 55G machine.

OPERATION

To move the switch points, the motor drives the intermediate gear train and the main gear. The lower end of the roller bearing stud in the main gear engages the cam bar via a link. As the main gear rotates from either extreme position, it pushes the cam bar toward the wire entrance end of the machine. This moves the dog on the cam bar out of the notch in the lock rod, unlocking the switch points and simultaneously causing the two rollers on the point detector yoke to be centered in the lock dog. Thus, the point detector yoke is moved to the vertical position to open the normal and reverse contacts and to close the motor control contacts. Continued rotation of the main gear causes the roller bearing to move the throw bar six inches. The throw bar moves the switch points which, in turn, move the lock and detector rods.

When the switch points close in the opposite position, the point detector rod is in position so that the point detector yoke and the attached contact block are forced by spring pressure to close the opposite indication contacts. This occurs during the last stage of the cam bar movement, when the bar is withdrawn from the detector yoke rollers and simultaneously locks the lock rod in position.

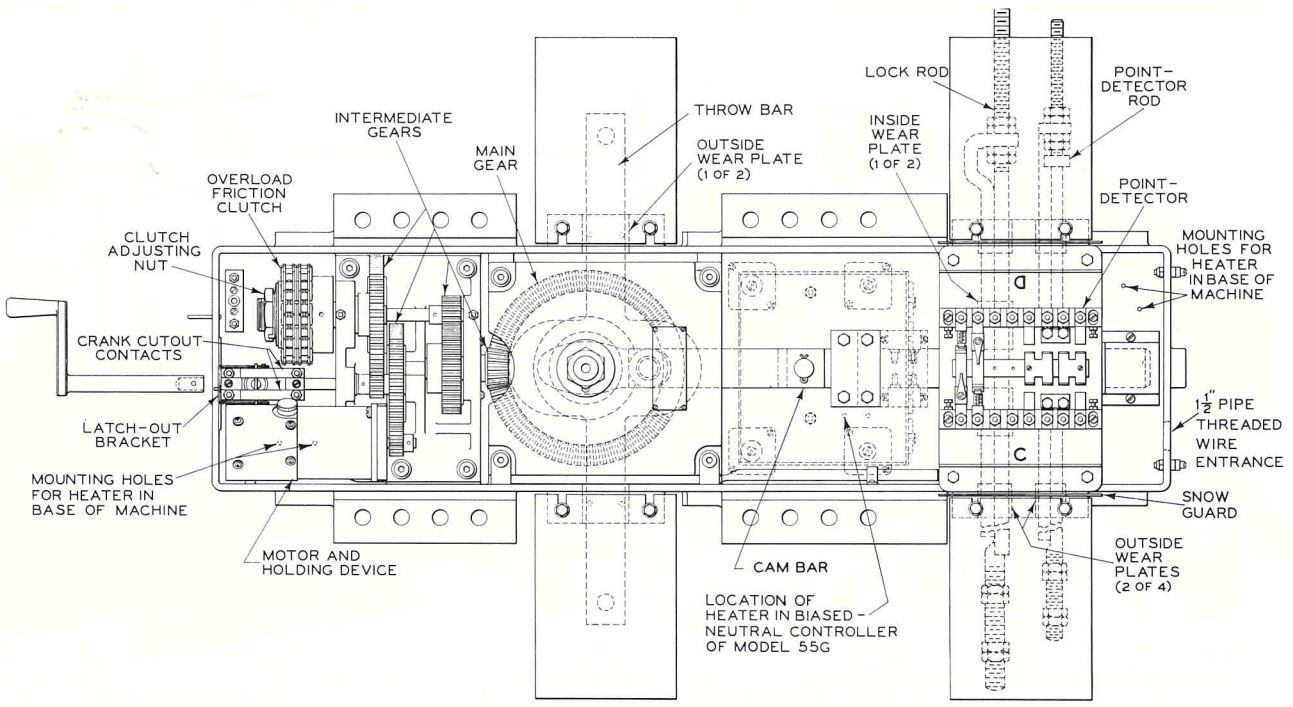


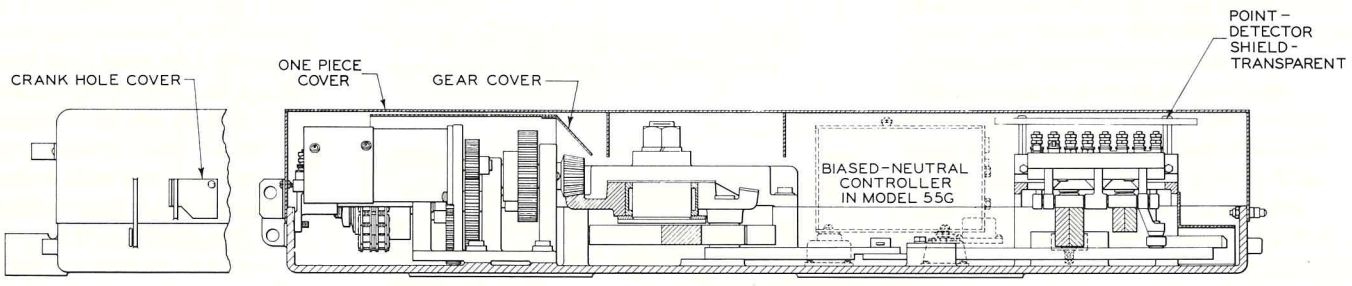
CAM BAR ASSEMBLY - SIDE VIEW

INSTALLATION

Installation and adjustment of the switch machine is relatively straightforward. Its versatility permits a number of configurations, some of which can be changed in the field.

A right-hand machine is one located on the right-hand side of the track when the observer faces the switch points. Machines ordered with one lock rod and one point detector rod are shipped in the right-hand configuration only. These can be easily altered in the field to left hand by reversing the lock rod and point detector rod in the machine and by moving the throw bar connection to the opposite end. Complete operation, installation, and maintenance data are contained in Pamphlet 1217.

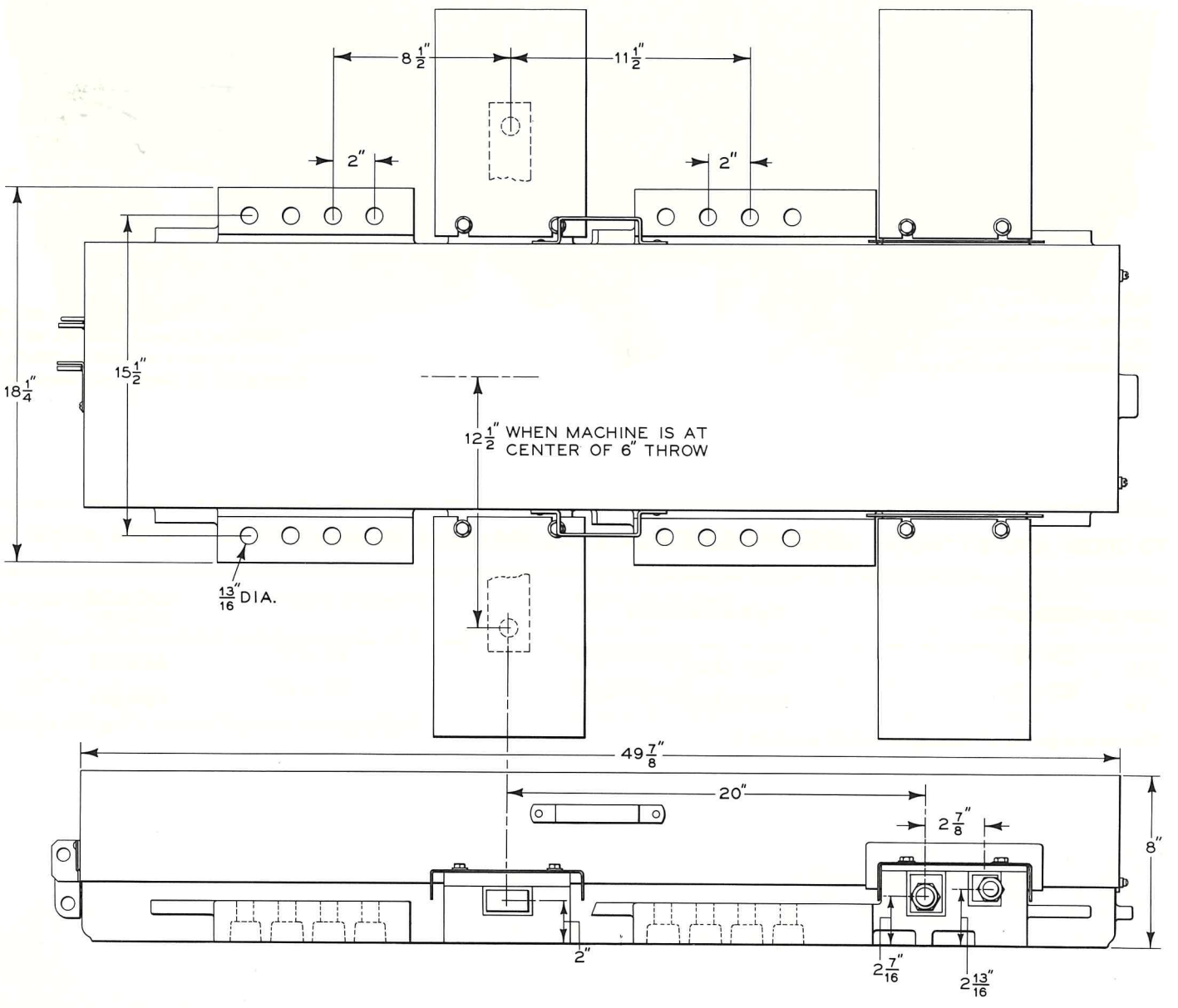




ORDERING INFORMATION

Models 55E and 55G switch machines are provided with one lock rod and one point detector rod for control of a single switch, single-slip switch, derail, or double-slip switch. Machines with two lock rods and two detector rods are available; see your GRS sales engineer for details.

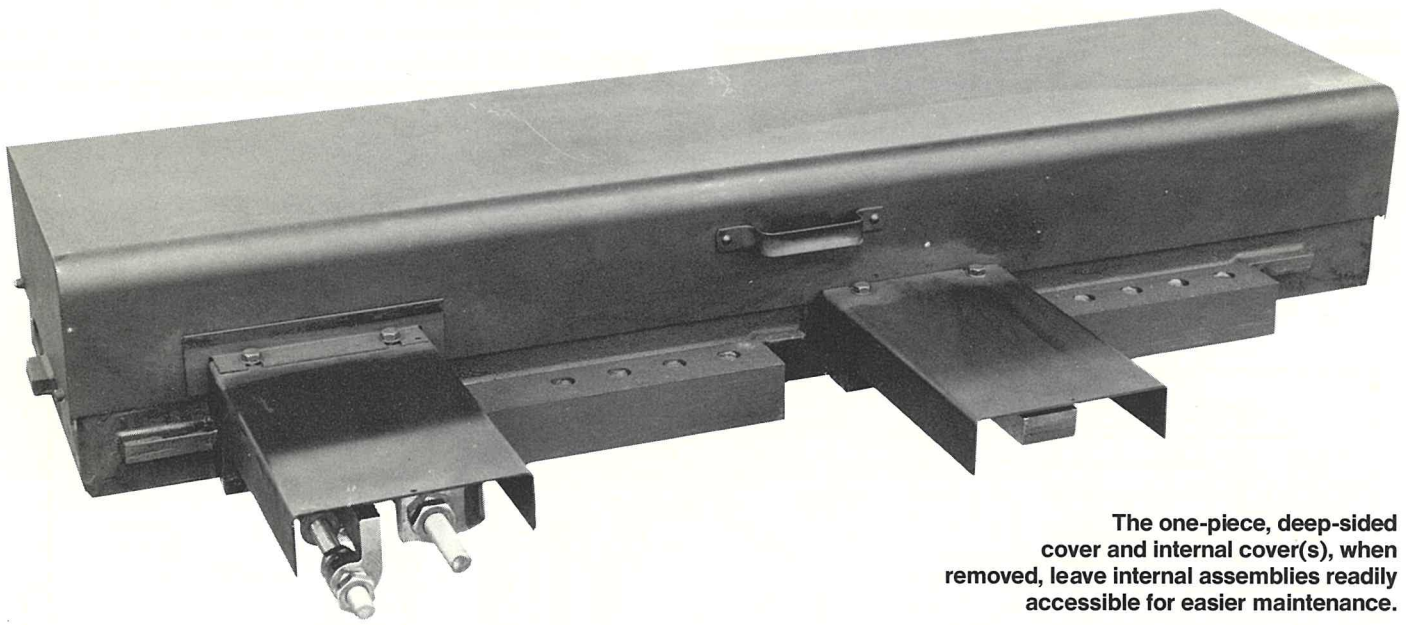
NOTE: If you desire to have GRS select all parts for a complete switch layout, please complete the questionnaire on the inside back cover.



MODEL 55E SWITCH MACHINE

The Model 55E DOES NOT INCLUDE the following; please order separately:

- **Accessories; see page 10.**
- **Type B or Type K switch control and switch overload relays; see Assemblies Catalog Sections 62 and 65.**
- **Lock and point detector connecting rods, throw rods, and junction boxes; see Assemblies Catalog Section 91.**



The one-piece, deep-sided cover and internal cover(s), when removed, leave internal assemblies readily accessible for easier maintenance.

TO ORDER, SPECIFY "MODEL 55E SWITCH MACHINE" AND GIVE CATALOG NUMBER.

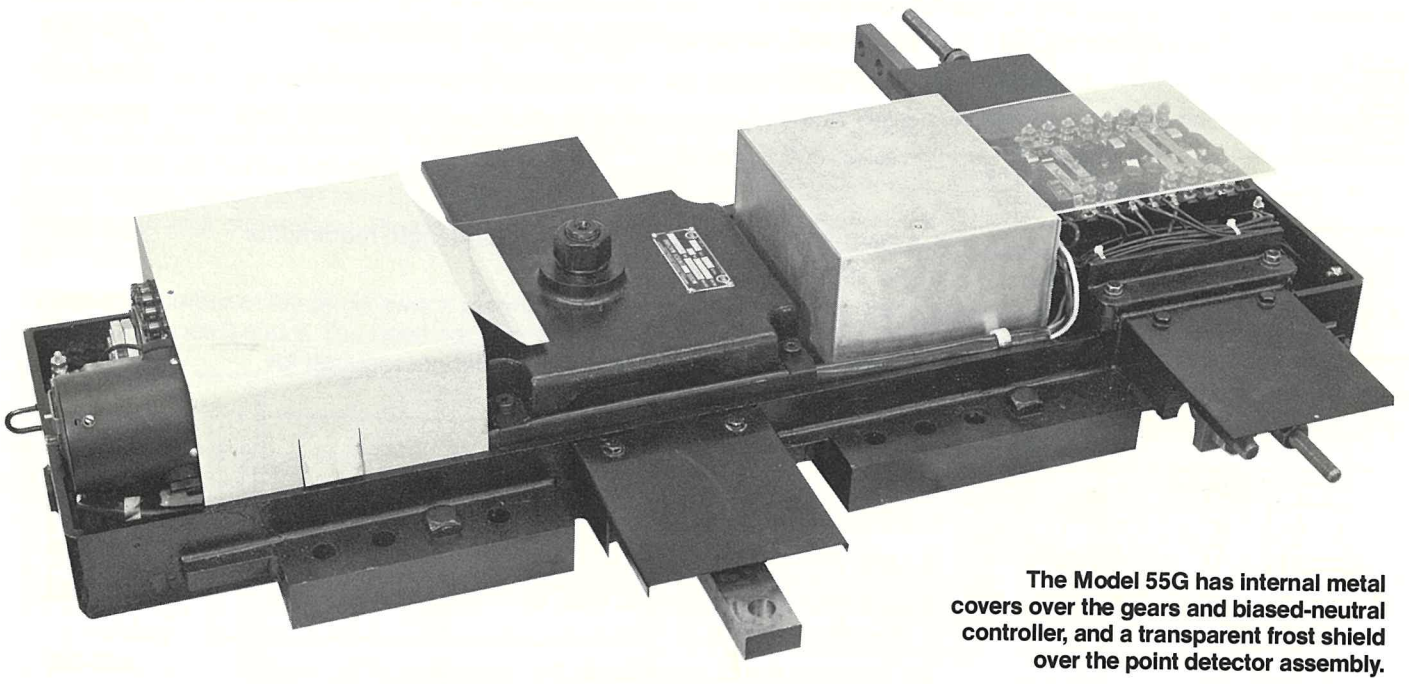
Operating Voltage D-c	Right or Left Hand	CATALOG NUMBER
110	Right Only*	**A85-900**
24	Right Only*	**A85-901**

*Can be changed to left-hand layout in field; see page 6.

MODEL 55G SWITCH MACHINE

The Model 55E DOES NOT INCLUDE the following; please order separately:

- **Accessories; see page 10.**
- **Lock and point detector connecting rods, throw rods, and junction boxes; see Assemblies Catalog Section 91.**



The Model 55G has internal metal covers over the gears and biased-neutral controller, and a transparent frost shield over the point detector assembly.

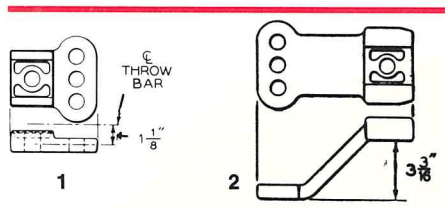
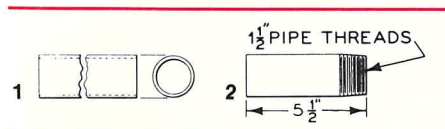
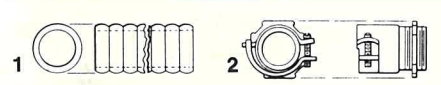
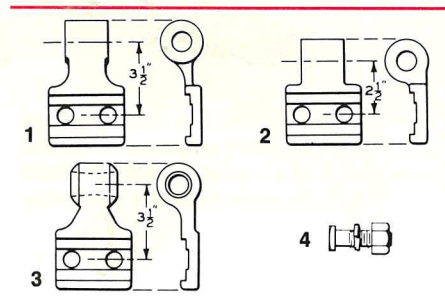
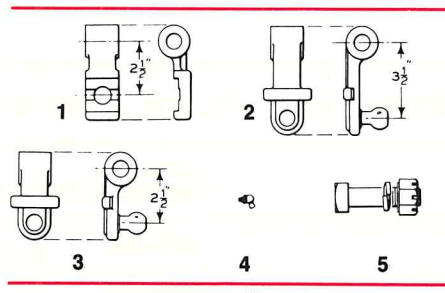
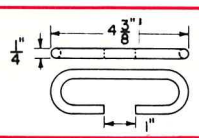
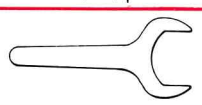
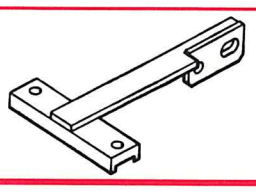
TO ORDER, SPECIFY "MODEL 55G SWITCH MACHINE" AND GIVE CATALOG NUMBER.

Operating Voltage D-c	Control Voltage D-c	Right or Left Hand	CATALOG NUMBER
110	10 or 24	Right Only*	**A85-905**
24	10 or 24	Right Only*	**A85-906**

*Can be changed to left-hand layout in field; see page 6.

ACCESSORIES

PLEASE ORDER BY CATALOG NUMBER AND NAME SHOWN IN BOLD TYPE

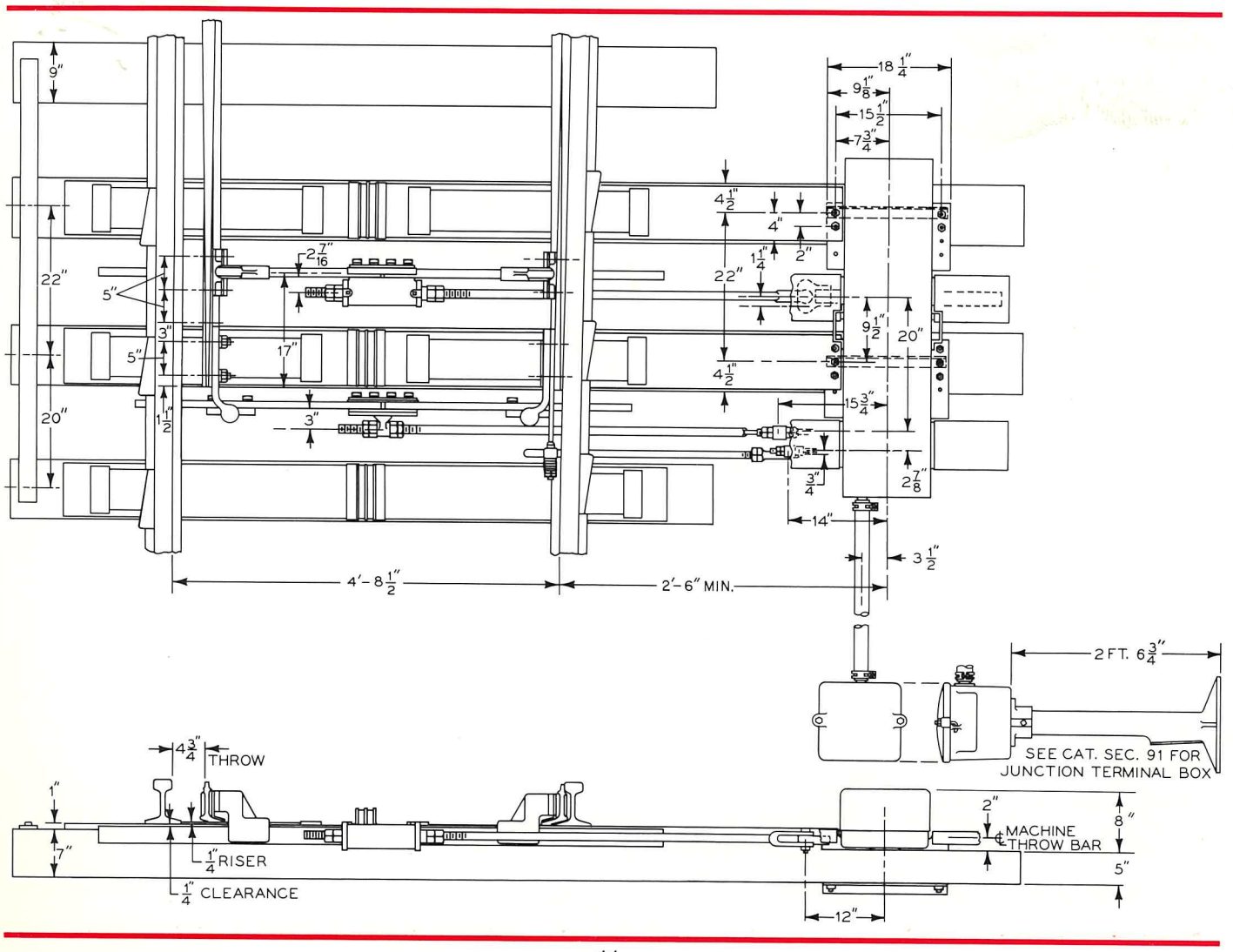
REFERENCE		CATALOG NUMBER
	**1. COUPLING,** throw-bar, fits layouts with dapped ties.	**P85-1009**
	2. COUPLING, throw-bar, fits layouts with non-dapped ties.	**P85-1214**
	BOLT, for fastening coupling to throw bar, includes nut, lock washer, and cotter pin.	**P85-1210**
	**1. CONDUIT,** 1⅞″ I.D. solid rubber, specify length required for use with pipe nipple.	**A85-520**
	2. PIPE NIPPLE, 1½″ pipe thread.	**P85-1003**
	**1. CONDUIT,** 1½″ flexible metal, specify length required for use with coupling.	**A85-868**
	2. COUPLING, 1½″ pipe thread.	**A85-866**
	**LUGS,** lock rod	
	1. LUG, 3½″ spacing, for 1″ diameter lock rod.	**A85-560**
	2. LUG, 2½″ spacing, for 1″ diameter lock rod.	**A85-561**
	3. LUG, 3½″ spacing, swivel type, for 1″ diameter lock rod, includes cup nuts.	**A85-562**
	3A. Same as Ref. 3, except with 2½″ spacing.	**A85-568**
	4. BOLT, complete with nut and washer, for fastening lugs. Refs. 1, 2, 3 to lock connecting rod.	**P85-1211**
	**LUGS,** detector rods	
	1. LUG, 2½″ spacing for ¾″ diameter detector rod.	**A85-563**
	2. LUG, 3½″ spacing, for ¾″ diameter detector rod.	**A85-564**
	3. LUG, 2½″ spacing, for ¾″ diameter detector rod.	**A85-565**
	4. GREASE FITTING, for detector rod lug.	**P87-101**
	5. BOLT, complete with nut and washer, for fastening lugs. Refs. 1 and 2.	**P85-1213**
	**GAUGE,** for adjustment of point detector rod without releasing lock rod.	**P85-1216**
	**WRENCH,** for adjusting clutch, 2⅜″ open end.	**P85-974**
	**TEST BAR,** provides means to check operation of machine and circuits before connecting machine to switch.	**P85-1215**

QUESTIONNAIRE
COMPLETE SWITCH LAYOUT

If you wish, GRS can select all parts for you to make up a complete layout as shown here (but not including: rails, rail fastenings, ties, tie straps, number one rod, or gauge plates). Bolts furnished will be for full length, one-inch thick gauge plates as shown. Also, the necessary connecting plate, bolts, insulation, etc., will be included to insulate your number one rod. Front rod and junction terminal box will not be included unless you specify same. If your switch fittings differ from the layout shown below, please state your dimensions. Please give us the following information:

1. Catalog number of Model 55 switch machine you want. Refer to pages 8 and 9. You need not specify conduit, lugs, etc., unless you have a particular preference, as we will select them for you.
2. Characteristics of your number one rod:
   Horizontal:_____ Vertical:_____ Inches thick:_____
3. Distance from centerline of switch machine to gauge of rail:_____
4. Weight of rail:_____
5. Do you wish to include:
   Junction Terminal Box A91-230?
   Yes:_____ No:_____

Front Rod? If so, please select from Catalog Section 91 and state catalog number:_____



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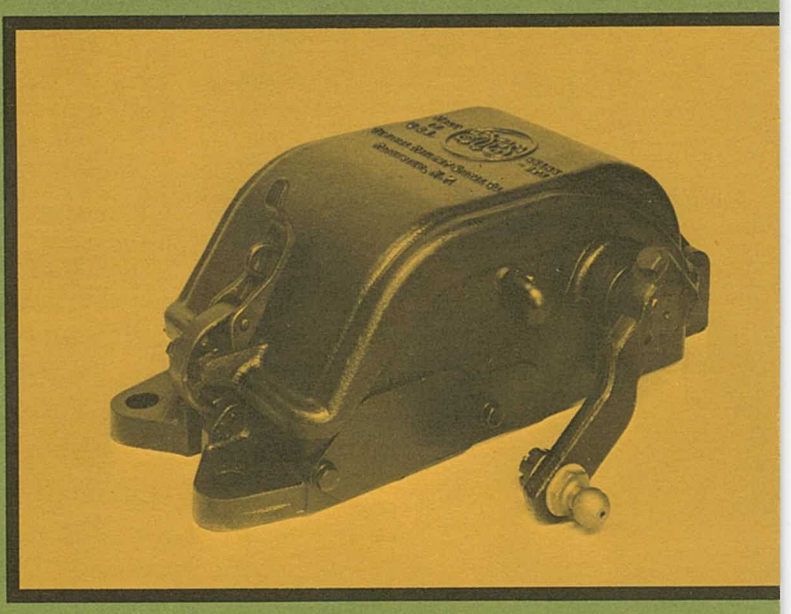
REPRESENTATIVES AND LICENSEES THROUGHOUT THE WORLD.

GRS CATALOG 81-1

Models 7J and 7K

SWITCH CIRCUIT CONTROLLERS



RUGGED – *heavily reinforced case, 1 1/2-inch cold-drawn steel shaft, corrosion and wear-resistant cams, spring steel cam surfaces.*

SENSITIVE – *a 3-degree movement of the crank actuates the contacts.*

RELIABLE – *positive action contact mechanism, spring contact pressure, withstands vibration.*

VERSATILE – *cams adjustable to operate contacts simultaneously or progressively, left- or right-hand operation, wide choice of fittings and accessories.*

GENERAL RAILWAY SIGNAL COMPANY
A UNIT OF GENERAL SIGNAL
ROCHESTER NEW YORK 14602

INTRODUCTION

The Model 7 line of switch circuit controllers meets the rigorous demands of the rail industry — high sensitivity, reliability, and rugged strength to withstand great mechanical stress under a wide range of environmental conditions.

The Model 7 consists of four sets of front-back contacts housed in a cast-iron case with a cast-aluminum cover. A mechanical linkage to the crankarm of the controller actuates the contacts. Thus, the controller may be used to integrate the positions of various devices with a suitable control circuit. Commonly used with switches to detect switch positions, Model 7 controllers can also detect the positions of derails, bridge locks, slide detectors, etc. They can shunt track circuits as well as control relay circuits.

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MODEL 7 FEATURES

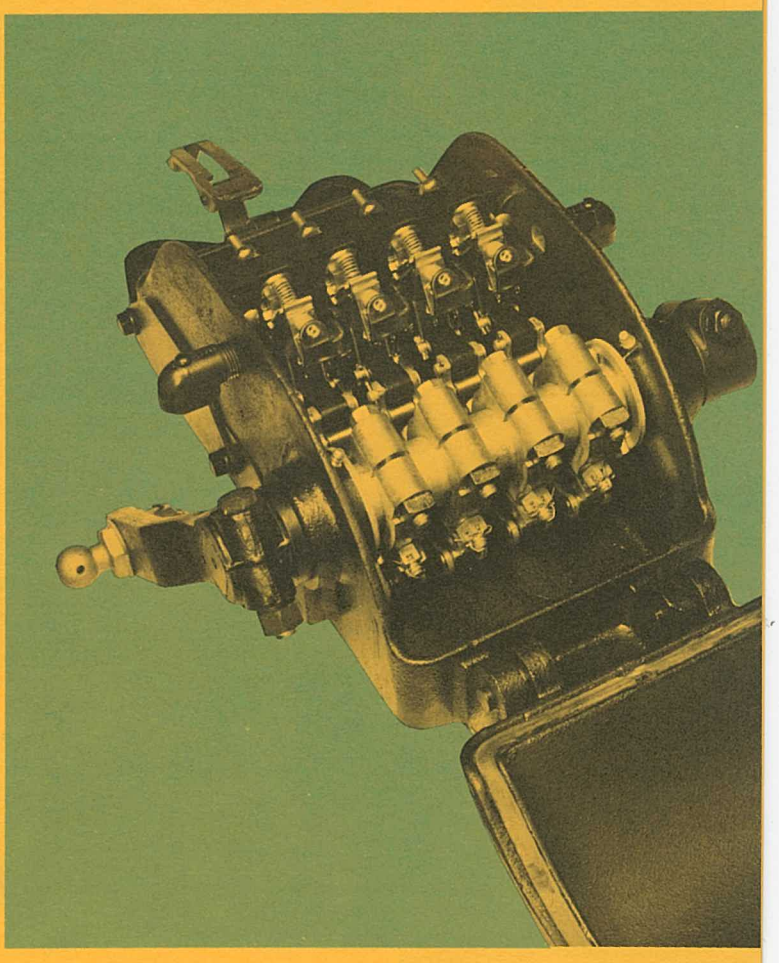
Arch Construction

The arched, cast-iron case provides great mechanical strength, eliminates projecting corners, and offers full access to all internal parts. Across the inside of the cast aluminum cover are two reinforcing bridges. With the cover closed, a bridge gasket bears against the top of the terminal board. This seals the terminal compartment from the mechanism compartment, prevents grease and oil from collecting on wires and terminals.

The outside rim of the cover is also gasketed, and a spring-type padlock hasp keeps the cover tightly closed. Dirt and moisture are effectively sealed out.

Hinged low on the case, the cover swings down out of the way or, if space is limited, can be easily removed. Internal parts are fully exposed. Wire connections, inspections, and adjustments are easy to make.

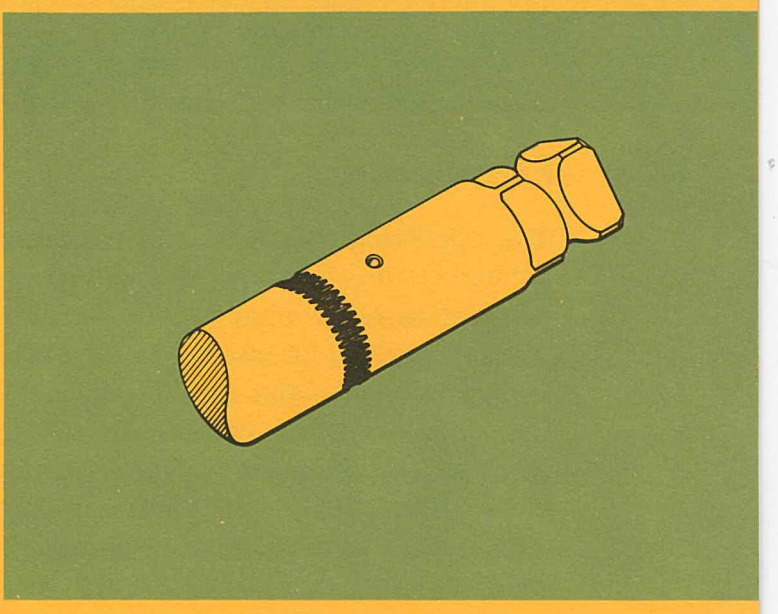
Screened ventilators help equalize internal and external temperatures, thus minimizing internal condensation.



Large Camshaft

The camshaft is a full one and a half inches in diameter. Made of cold-drawn steel for strength and cadmium plated for corrosion resistance, this large shaft provides rigidity and strength for dependable controller operation and long life.

The shaft is mounted in replaceable bronze bearings, pressure lubricated through annular grease grooves. One and one eighth inches square at each end, the shaft provides firm mounting for the crank arm, right- or left-hand, as desired.

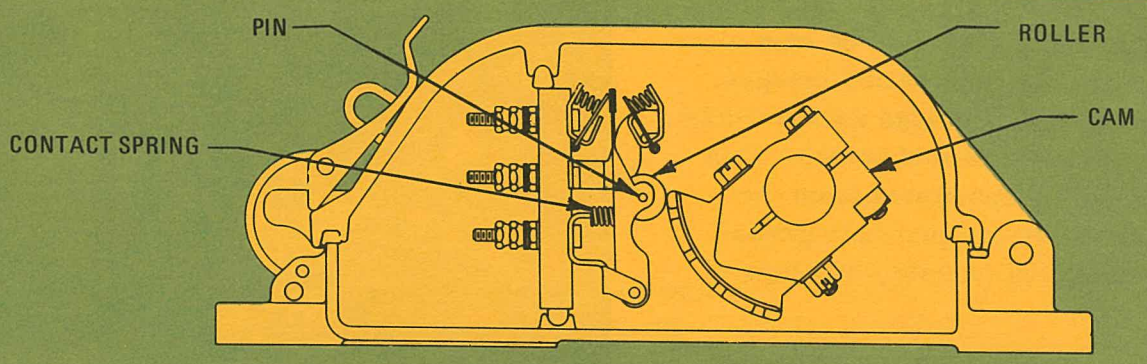


Wear-Protected Rollers

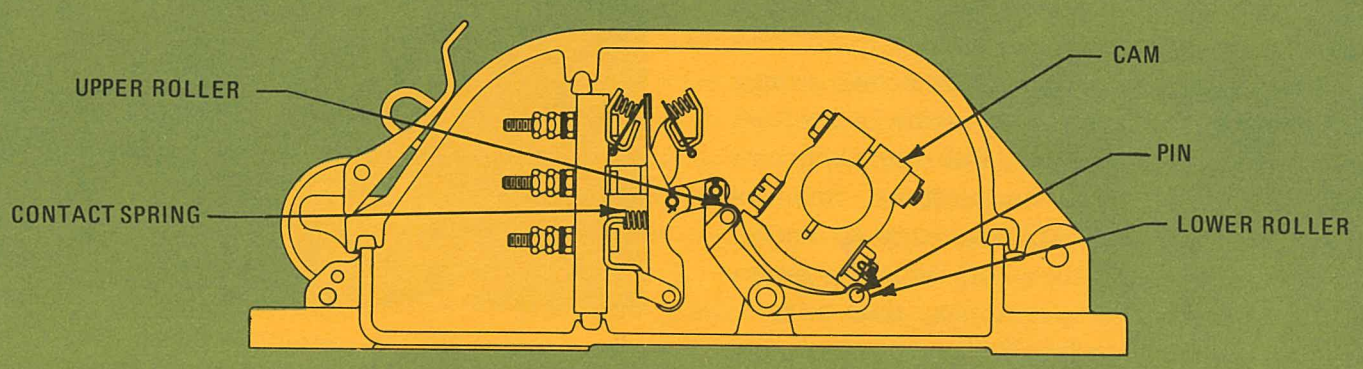
Made of bakelite-impregnated fabric, the Model 7J rollers have great mechanical strength and high dielectric characteristics. Long-wearing bushings, molded into the rollers, revolve on heat-treated, stainless-steel pins.

Made of hardened steel, the Model 7K rollers also have great mechanical strength. They revolve on strong, corrosion-resistant pins, made of a copper-silicon alloy.

The roller designs in the Models 7J and 7K controllers protect against the development of flat spots on the rollers and the formation of corrosion on the pins. The rollers always roll over the cam surfaces — never slide.



MODEL 7J



MODEL 7K

Protection

The operating mechanisms are supersensitive to detectable motion, yet isolate the contacts from vibration. The cam faces and the cam shaft are concentric — they rotate parallel to each other. Thus, crank movements due to vibration cannot affect the contact fingers. Contacts do not chatter. Vibration wear is eliminated.

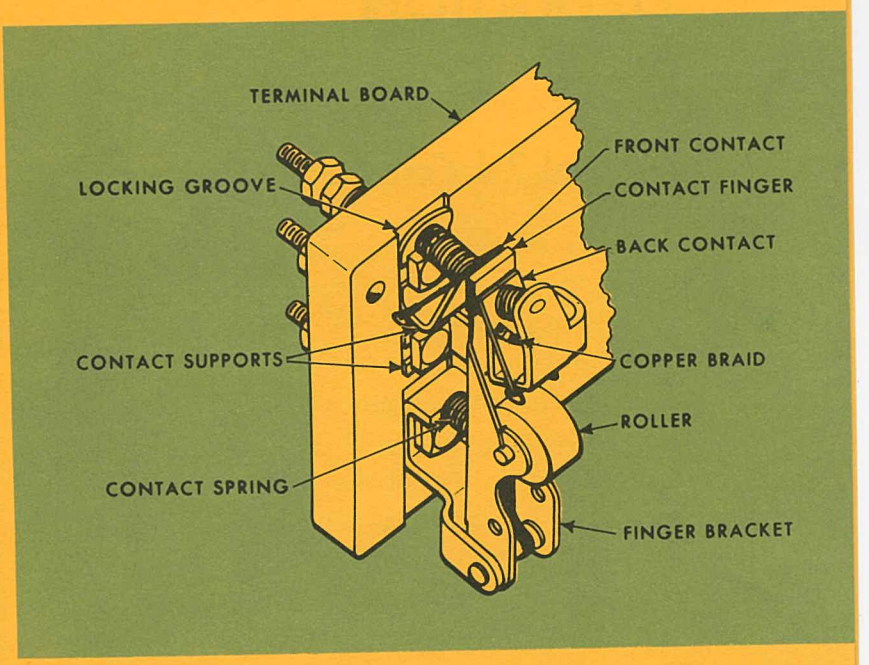
Furthermore, the controller contacts are held tightly closed. In the Model 7J, the combined effect of cam and spring pressure on the contact fingers provides high front-contact pressure. Contact springs hold the fingers firmly against the back contacts. The rocker assemblies in the Model 7K use cam and spring pressure to hold the contacts firmly, in their closed position. The contact fingers move only when the crank position changes — not with crank or case vibrations.

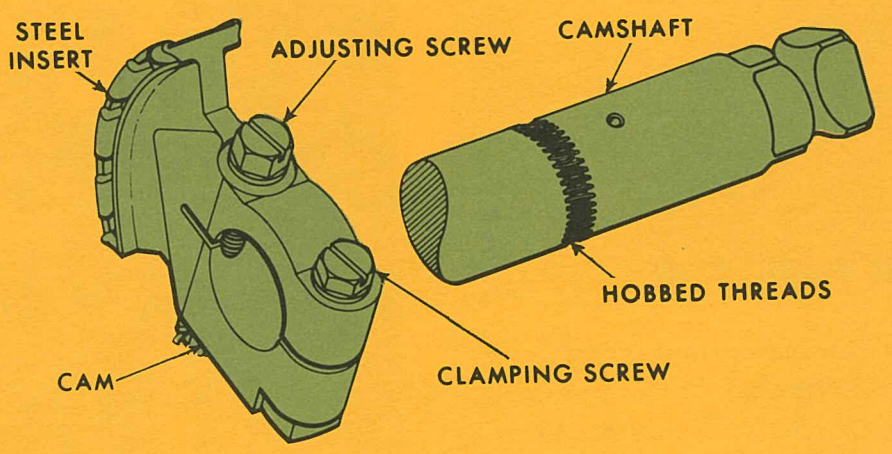
Contact Arrangement

Since the front and back contacts are articulated, they cannot take a permanent set due to bending. Firmly seated in locking grooves, the supports keep the contacts properly aligned. Coil springs between the contacts and their supports give high contact pressure and long contact wipe. Flexible copper braid electrically bonds each contact to its support.

The contact fingers are channel shaped for increased strength. Contact springs hold the fingers tightly against the contacts.

Silver contact surfaces provide high electrical conductivity.





Adjustment

Each of the four cams can be separately adjusted to operate its associated contacts at any desired position of the actuating device.

Any cam can be adjusted easily — and with great accuracy — by loosening the clamping screw and turning the adjusting screw. Precisely fitted to hobbed threads in the shaft, the cam can be moved around the shaft to the exact position desired. Tightening the clamping screw locks the cam securely in position.

The screws are easy to reach — no need to disconnect the external linkage and rotate the shaft until the screws are accessible.

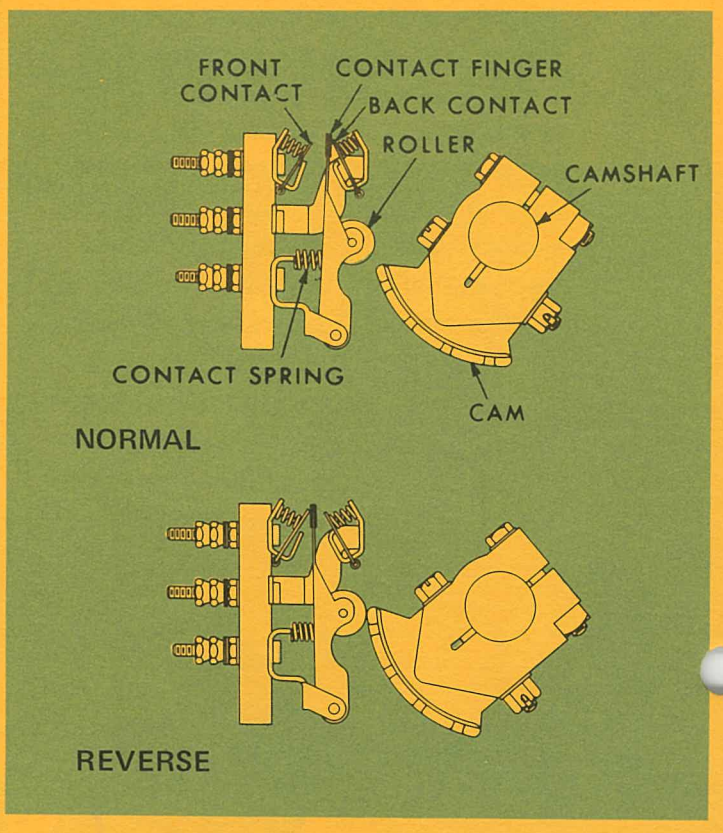
Made of die-cast aluminum, the cams resist rust and corrosion. Hardened, spring-steel inserts on the roller contacting surfaces protect against cam wear.

OPERATION

Model 7J Cam and Roller

With the switch in the normal position, the pressure of the contact spring holds the contact finger firmly against the back contact.

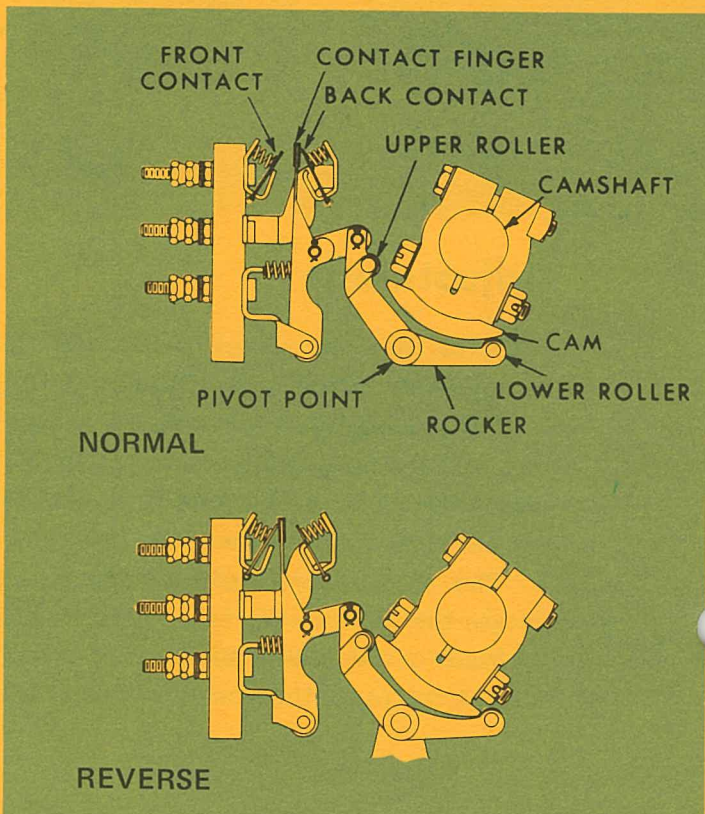
When the switch points are moved toward reverse, the hardened steel cam face presses against the roller attached to the contact finger. The roller moves up on the cam face, and the contact finger moves, against the pressure of the contact spring, to open the back contact and close the front contact.



Model 7K Push-Pull

With the switch in the normal position, the cam holds the rocker down, and the contact finger is positioned against the back contact.

When the switch points are moved toward reverse, the cam presses down on the upper roller of the rocker. The rocker pivots, and the contact finger moves, against the pressure of the contact spring, to open the back contact and close the front contact.



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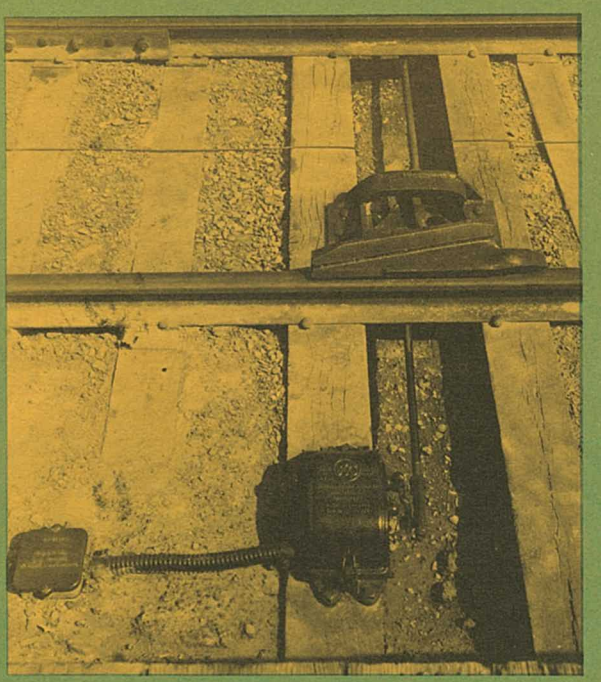
APPLICATIONS

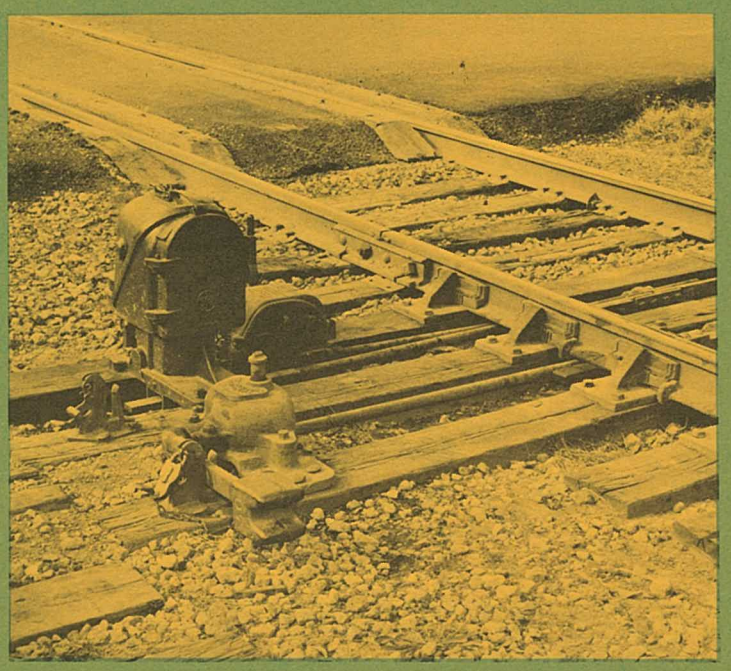
Use Model 7's to detect:

- Switch point postions, normal and reverse
- Switch point locking
- Bridge locking
- Bridge positions
- Tunnel door positions
- Slide detector actuation

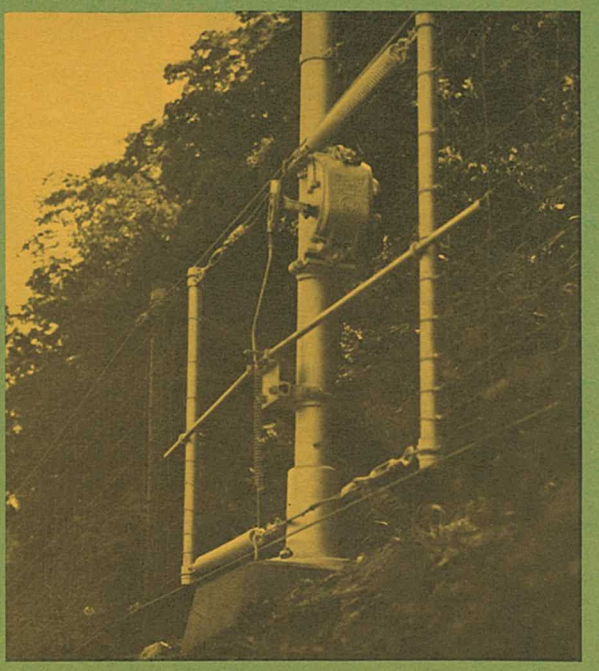
- Use a Model 7J or 7K switch circuit controller wherever you need reliable, "circuit-open" or "circuit-closed" indication of the position of any substantial two-position device.



Controller at a derail installation.



Controller and Model 9B lock at a switch location.



Controller on a slide detector fence.

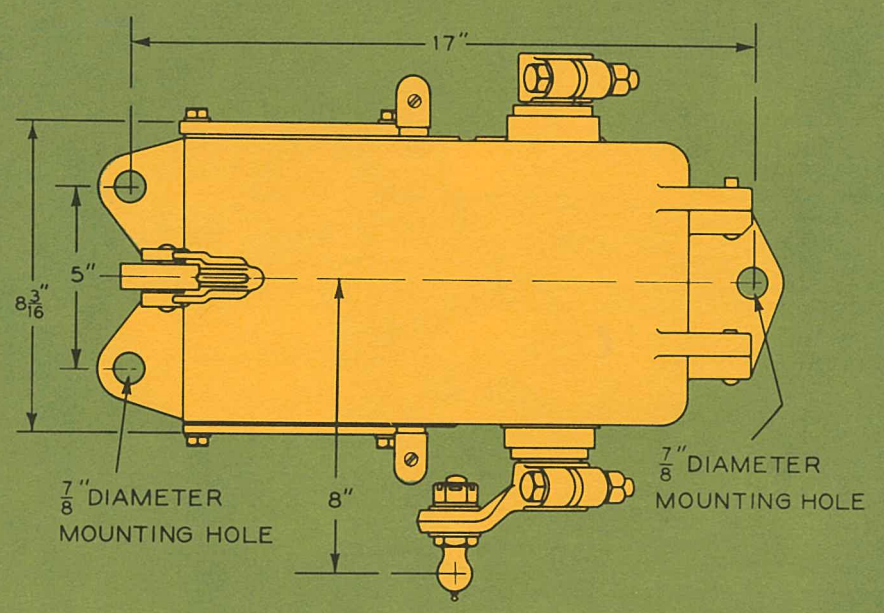
INSTALLATION

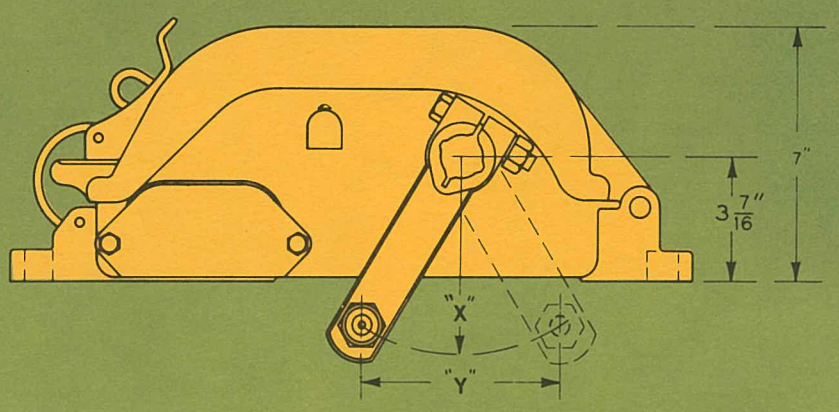
Model 7 controllers are easy to install. They are compact, have low clearance profile, and mount on a single tie.

The two mounting holes at the hasp end of the case are spaced on five-inch centers — ample room for a wrench. The third mounting hole, at the opposite end of the case, is also conveniently located.

The controller should be installed so that it cannot move in relation to the switch rails or actuating device. Install the operating rod and point lug connections — or other mechanical linkage — so that there is little or no lost motion.

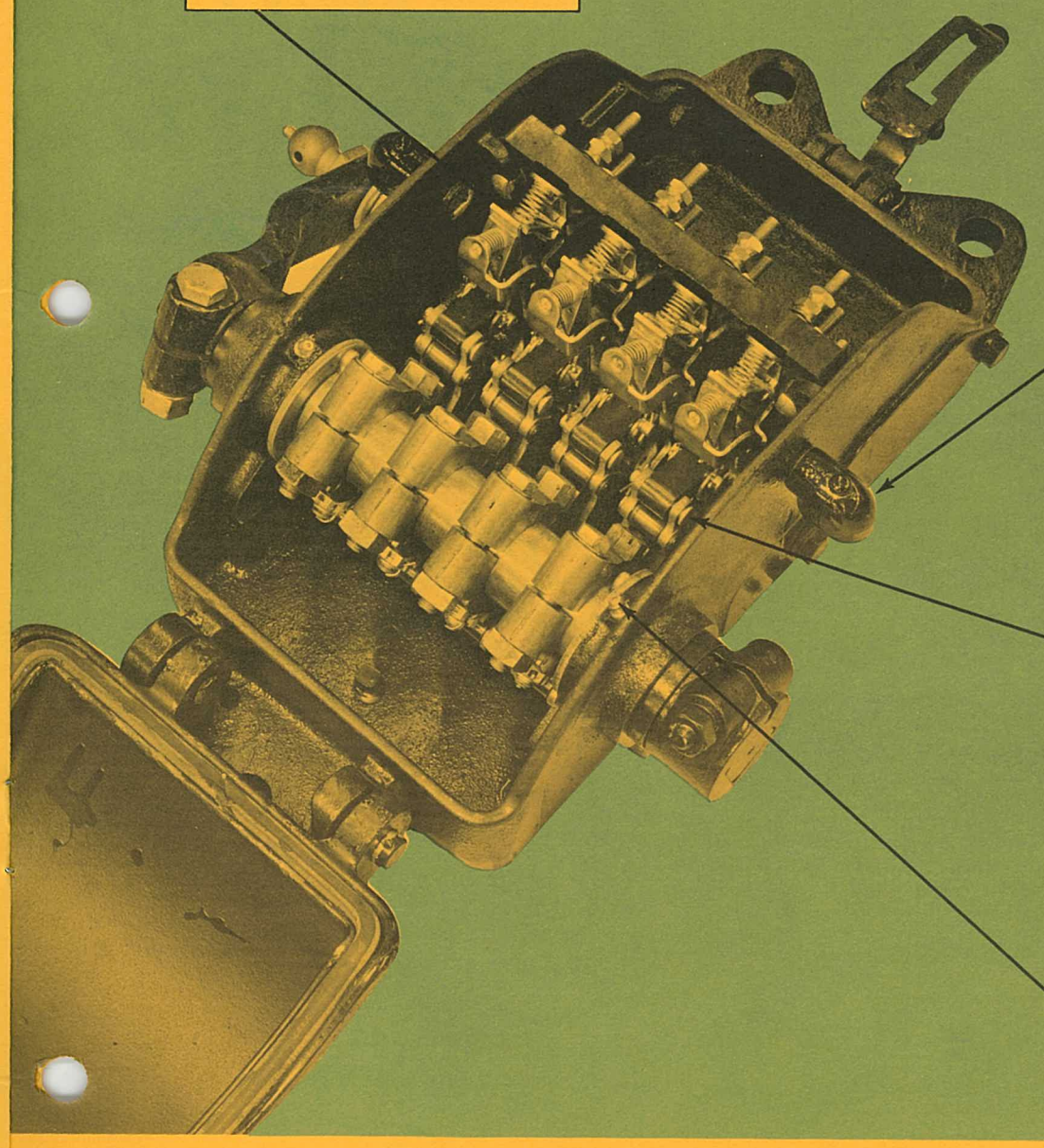
Two wire openings, one on each side of the case, are conveniently located at opposite ends of the terminal board. Your choice of wire-entrance fitting A81-130 or -131, page 11, is furnished with each controller. Other optional fittings and accessories are available to meet your installation requirements.





MAINTENANCE . . . is easy

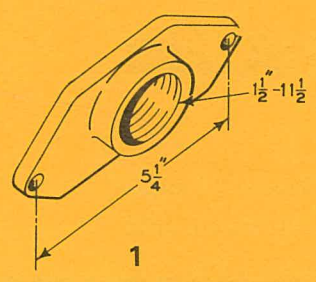
The contacts need only periodic inspection. When needed, cleaning and polishing with a burnishing tool quickly restores them to first-class condition.



Check ventilator screens regularly. Keep them open for proper air circulation.

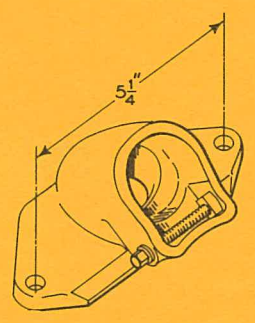
Lubricate the rocker-shaft bearings and the contact rollers and pins (Model 7K) or the roller bearings (Model 7J) periodically with GRS 2A semaphore oil. Remove any excess oil.

Lubricate the main bearings and the ball stud on the crank periodically with an all-temperature grease. Pressure grease fittings simplify lubrication .



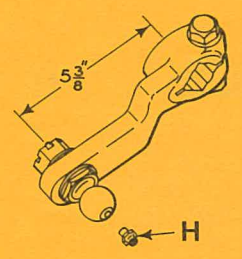
1

CAP FOR WIRE OUTLET



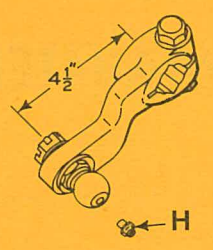
2

45° COUPLING



3

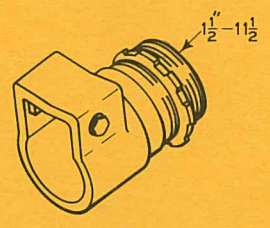
5-3/8" CRANK



4

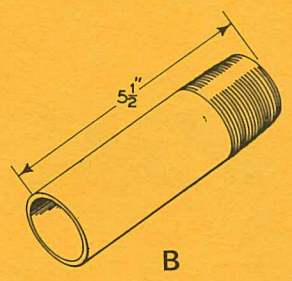
4-1/2" CRANK

Controllers complete are supplied with your choice of either 1 or 2 and your choice of either 3 or 4.



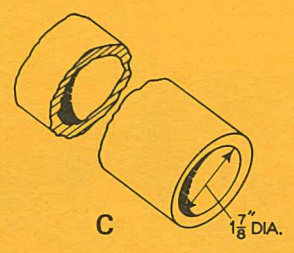
A

FLEXIBLE CONDUIT COUPLING



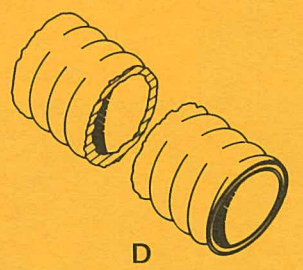
B

1-1/2" PIPE NIPPLE



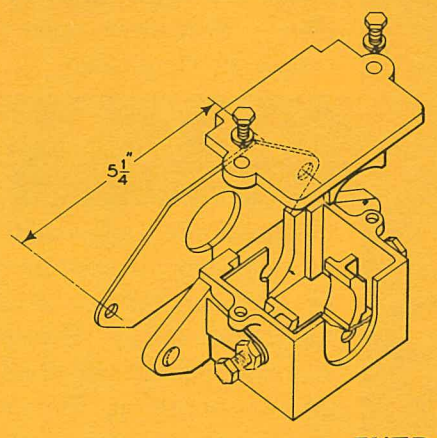
C

1-7/8" CONDUIT



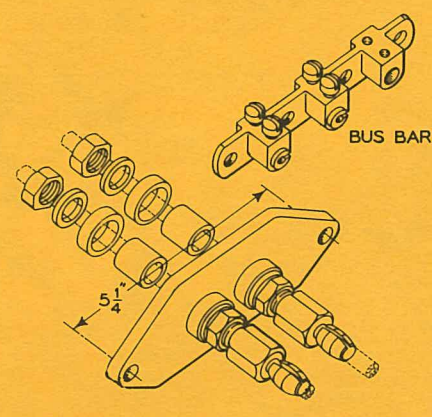
D

1-1/2" FLEXIBLE CONDUIT



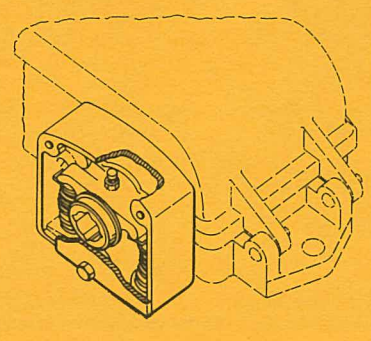
E

ENTRANCE SEAL



F

TERMINAL CAP



G

CENTERING ATTACHMENT

Accessories for switch circuit controllers

ORDERING INFORMATION

To order, specify Model 7J or 7K Switch Circuit Controller, choice of wire entrance coupling 1 or 2, and choice of crank 3 or 4, which are included with the controller. Please order accessories separately.

Please order by name, shown in BOLD TYPE, and catalog number.

REF.	NAME	CATALOG NUMBER
	MODEL 7J SWITCH CIRCUIT CONTROLLER	A81-100
	MODEL 7K SWITCH CIRCUIT CONTROLLER	A81-105
1	**CAP,** for wire outlet, with 1-1/2" std. pipe tapped hole	A81-130
2	**COUPLING,** 45 degree, for 1-1/2" flexible conduit	A81-131
3	**CRANK,** with insulated ball pin, 1" offset, 5-3/8" centers. See table below	A81-135
4	**CRANK,** with insulated ball pin, 1" offset, 4-1/2" centers. See table below	A81-137
	ACCESSORIES	
A	**COUPLING,** for 1-1/2" flexible conduit and with 1-1/2" std. pipe threads	A85-866
B	**PIPE NIPPLE,** 1-1/2" std. pipe threads, for 1-7/8" I.D. rubber conduit	A85-867
C	**CONDUIT,** 1-7/8" I.D. solid rubber, length 3'	A85-520
D	**CONDUIT,** 1-1/2" flexible, length 3'	A85-868
E	**ENTRANCE SEAL,** takes up to 1-1/2" dia. cable	A81-145
F	**CAP,** two required, for terminating shunt wires, for two .243" dia. cables, also includes one bus bar	A81-147
F1	**CAP,** two required,for terminating shunt wires, for two .190" dia. cables, also includes one bus bar	A81-149
G	**CENTERING ATTACHMENT,** for broken switch rod protection, includes gasket	A81-151
H	**OILER,** for cranks Refs. 3 and 4	P81-140

Maximum Throw of Cranks Refs. 3 and 4

Crank Ref.	Centers of Crank	Used on Switch Circuit Controller	*Max. Throw or Stroke
3	5-3/8"	Model 7J	6-1/2"
3	5-3/8"	Model 7K	7"
4	4-1/2"	Model 7J	5"
4	4-1/2"	Model 7K	5-7/8"

*Maximum permissible connecting rod movement.

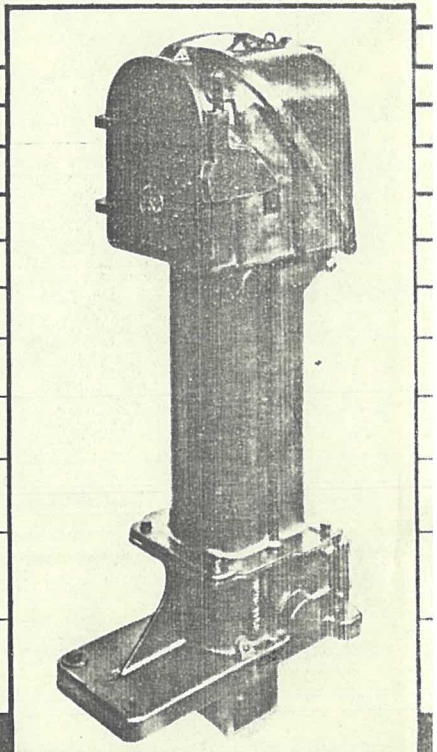
AJ

~~AALK~~

For Your Distribution

RG 5/23

G·R·S Model 9B Electric SWITCH LOCK



HANDBOOK
52

G·R·S Model 9B Electric SWITCH LOCK

Operation • Installation • Maintenance

HANDBOOK
52

APRIL 1955

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ROCHESTER 2, NEW YORK

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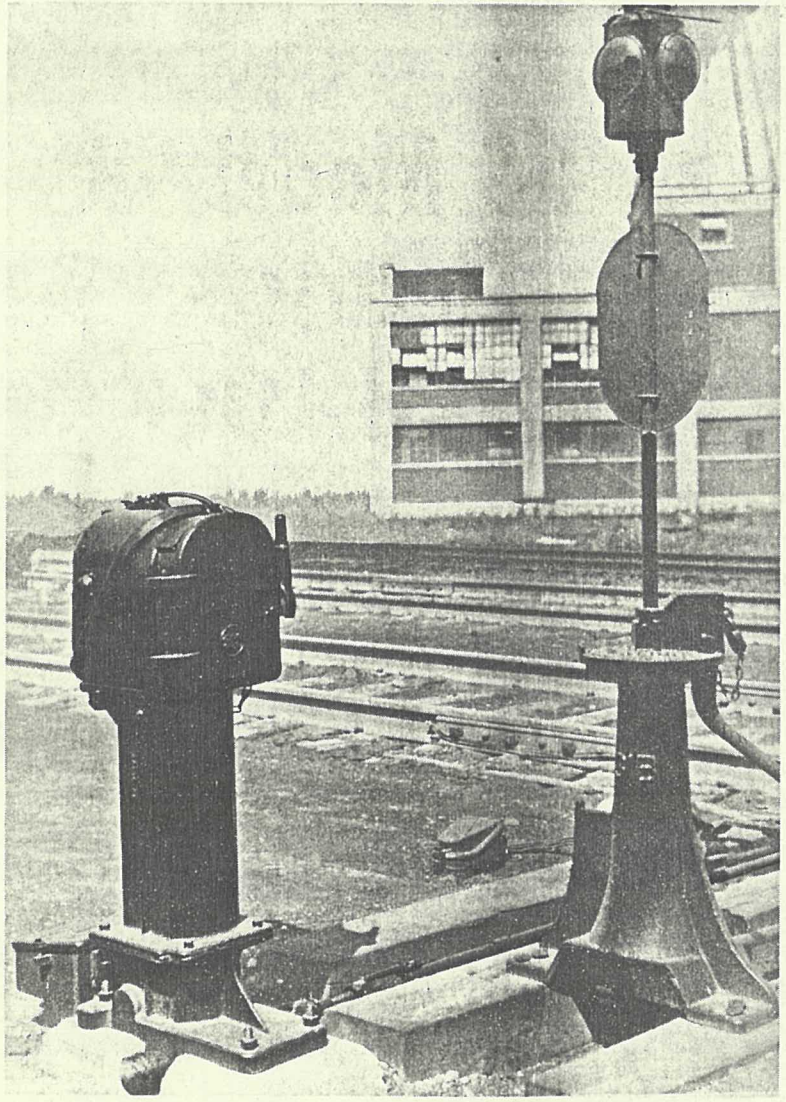


Figure 1. Model 9B lock with junction box on concrete foundation.

CONTENTS

GENERAL DESCRIPTION - MODEL 9B 5
Heights 5
Bases 5
Junction Box 9
Pedestal 10
Case 12
Indicators 13
Handle-Operated Contacts 15
Accessories 15
OPERATION 18
Operational Sequence (Normal Release) 19
Unlock Position 21
CIRCUITS 33
INSTALLATION 39
On Ties 39
On Concrete Foundation 39
Wiring Information 41
MAINTENANCE 43
Lubrication 43
Armature 43
Commutators 45
Banner Indicator 45
Accessories 46
Push Button 47
Door-Operated Circuit Controller 47
Cover 47
Removing Mechanism 49
Operating Values 50
A-c. Operation 50
MODELS 9C AND 9D LOCKS 51
Model 9C Lock 51
Model 9D Lock 51
ORDERING INFORMATION 51

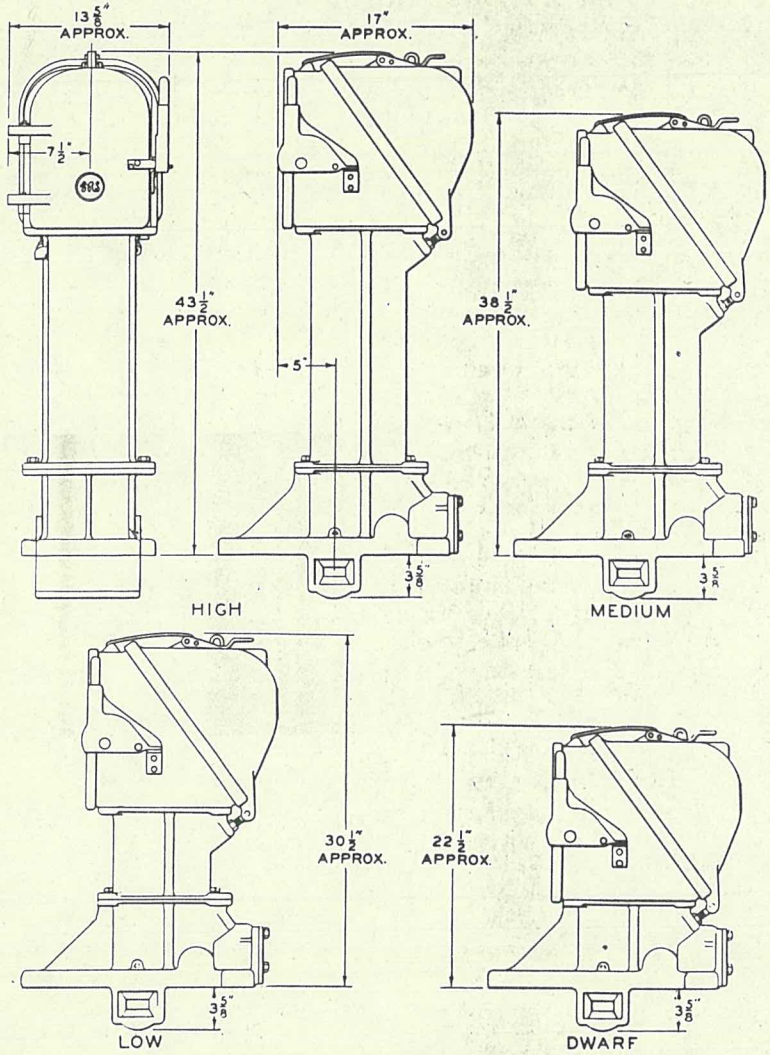


Figure 2. Four heights are available: high, medium, low, and dwarf.

GENERAL DESCRIPTION—MODEL 9B

The Model 9B, Figure 1, is an electrically operated switch lock in which the locking key is lifted from a notch in a locking dog by an electromagnet. This allows the trainman to raise the locking plunger out of its hole in the switch lock rod by operating the handle through 180 degrees to its full reverse position. This operation and these parts are explained in detail later.

The purpose of the Model 9B electric switch lock is to lock the lock rod on a switch. It may be used to lock the lock rod in one position only; or, when equipped with a double adjustable lock rod, in both the normal and reverse positions. It may also be used to lock any device which can be locked with a lock rod.

Heights

The lock is supplied in four heights, as shown in Figure 2. The height of a lock is varied by using pedestals of different heights between the base and the mechanism case. In the dwarf lock the mechanism case is bolted directly to the base.

Bases

The standard base is the open type, Figure 3A, designed

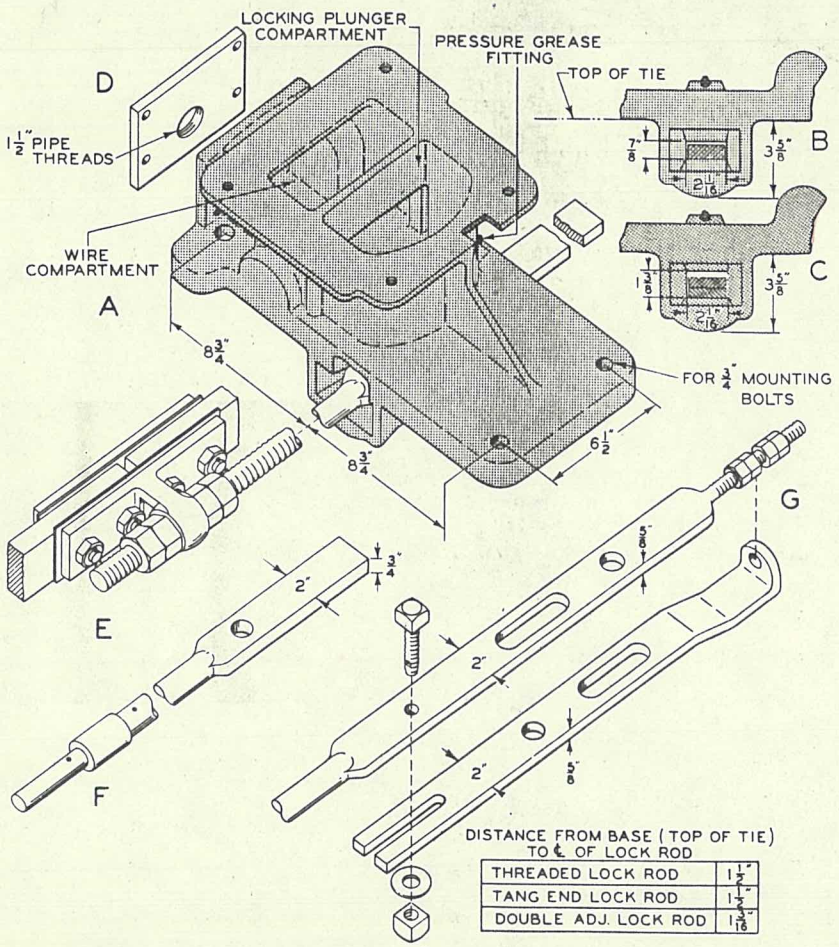


Figure 3. A-standard base.
B-base detail for single lock rod.
C-base detail for double adjustable lock rod.
D-wire entrance plate.
E-threaded end lock rod.
F-tang end lock rod.
G-double adjustable lock rod.

to be bolted to the pedestal, or directly to the mechanism case for a dwarf lock. It has two compartments, as does the pedestal, one for wires and the other for locking plunger. Either a wire entrance plate, D, or the junction box (see Figure 5) may be bolted to the wire compartment. A pressure grease fitting is provided for lubricating the locking plunger. Mounting hole centers are identical with the Model 9A lock so the 9B lock can be used in its place. This base can be furnished for either the single or the double adjustable lock rod as shown in Figure 3B and C. The open type base is the only base which will accommodate the double adjustable lock rod, Figure 3G.

The double adjustable lock rod for normal and reverse locking is made adjustable by combining two rods with slots and locking holes as shown. These are provided so that the locking plunger holes may be adjusted to fit throw of switch. Two types of lock rod ends are shown in Figure 3E and F, threaded and tang. The tang end lock rod is pipe-connected to the switch.

Single lock rods will be furnished drilled for closed point only unless otherwise specified.

A watertight base, Figure 4, is an optional feature on the

Model 9B lock. A stuffing gland, B, encloses the lock rod. Lock rods are available with threaded or tang ends. This arrangement provides locking in one position only. An enlarged cross-section of the stuffing gland is shown at C. Tightening the gland forces the packing snugly around the lock rod shaft, making the base watertight.

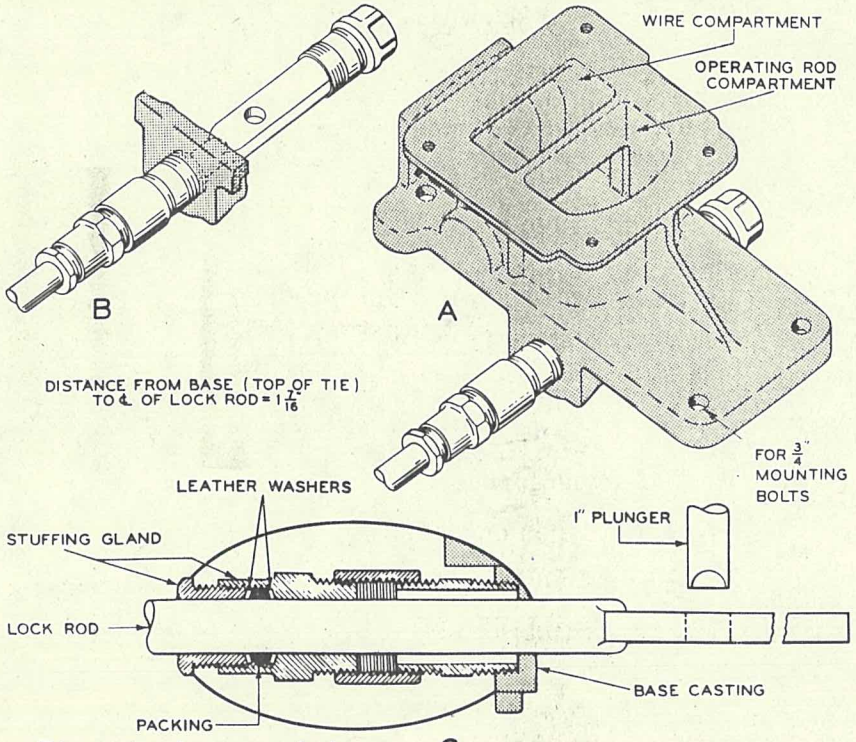


Figure 4. A-watertight base. B-stuffing gland. C-cross-section of stuffing gland.

Junction Box

The junction box, Figure 5, is an optional feature used when the lock is mounted on a concrete foundation. The junction box is fastened to the base of the lock with four cap screws in place of the wire entrance plate, Figure 3D, usually supplied. A sealing compound is used to seal the two adjoining surfaces. Cable may be brought directly into the junction box through a 1-1/2 inch pipe threaded fitting. Inside the junction box are two terminal blocks

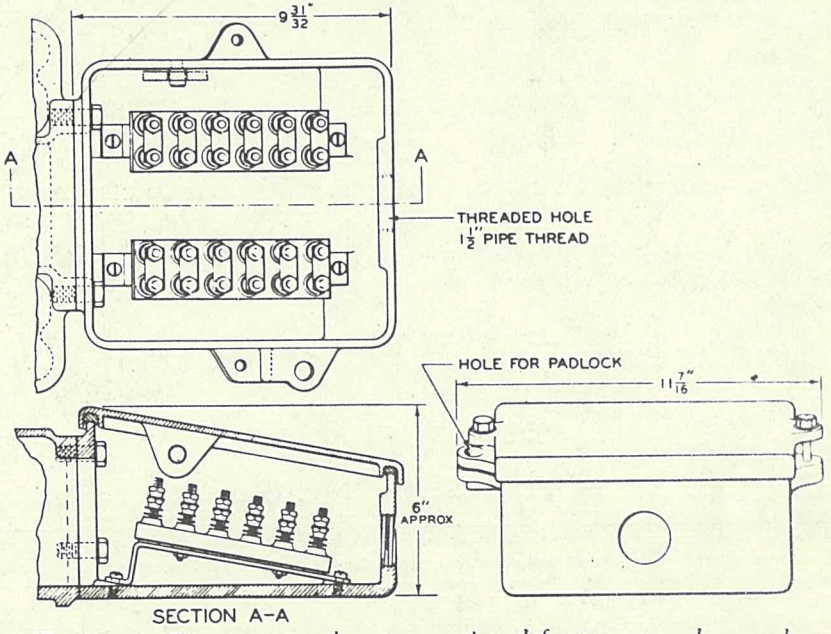


Figure 5. The junction box, an optional feature, can be used when the lock is mounted on a concrete foundation.

with twelve terminals to a block. The cover of the junction box is fastened down with two cap screws, necked to prevent losing them when the cover is removed. Matching padlock holes are provided on one side of the case and cover. To prevent the cover from being pried off at the opposite side, a lug is cast on the cover which fits over a pin projecting from inside the case. The cover is gasketed to provide a weathertight seal.

Space in the base and the pedestal allows ample room for wiring between junction box and mechanism case.

Pedestal

The cast iron pedestal, Figure 6, is divided into two compartments by a sheet metal partition. The front compartment contains the operating rod and locking plunger. The back compartment houses the wiring from the base to the mechanism. There is a ventilator in the pedestal near the top. The four smaller cap screws at the top of the pedestal are for bolting down the mechanism. Four larger cap screws hold down the case, which is open at the back. A separate filler bar, bolted to the rear of the pedestal, closes the gap in the case. Thus the case may be removed to expose the mechanism for easy maintenance.

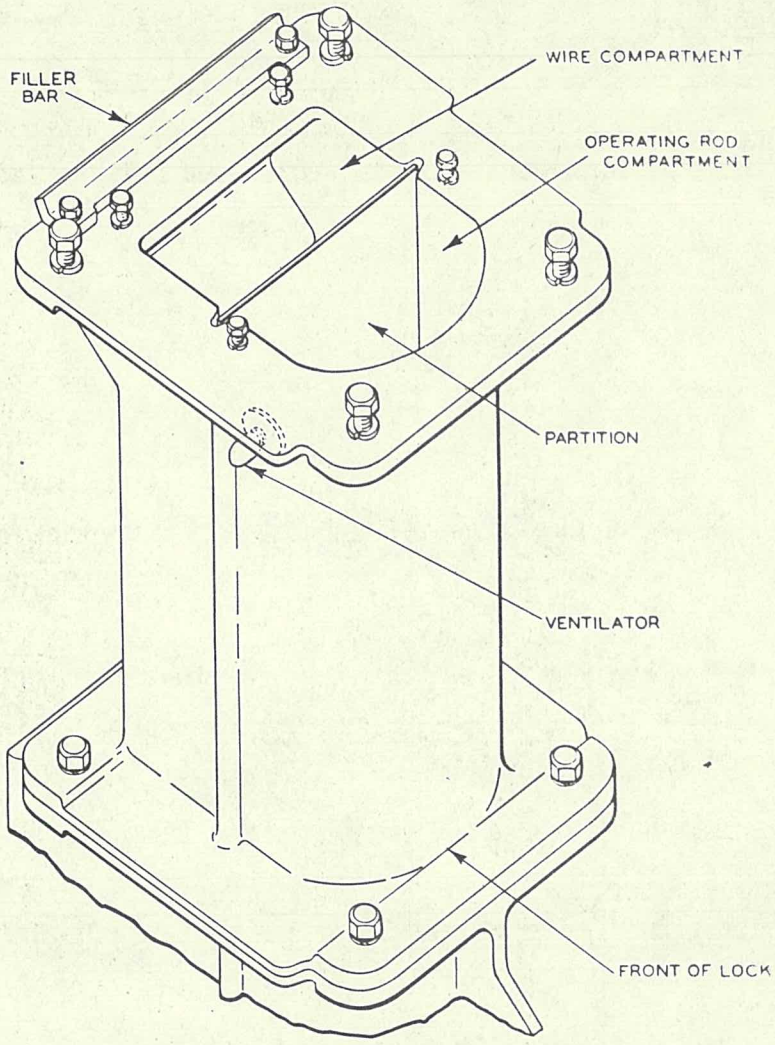


Figure 6. A cast iron pedestal supports the lock, has separate compartments for wiring and operating rod.

Case

The case, Figure 7, is made of cast iron with an integral partition separating the mechanism from the operating handle compartment. The indicator glass and bezel are fastened to the cast partition, just below the top of the case.

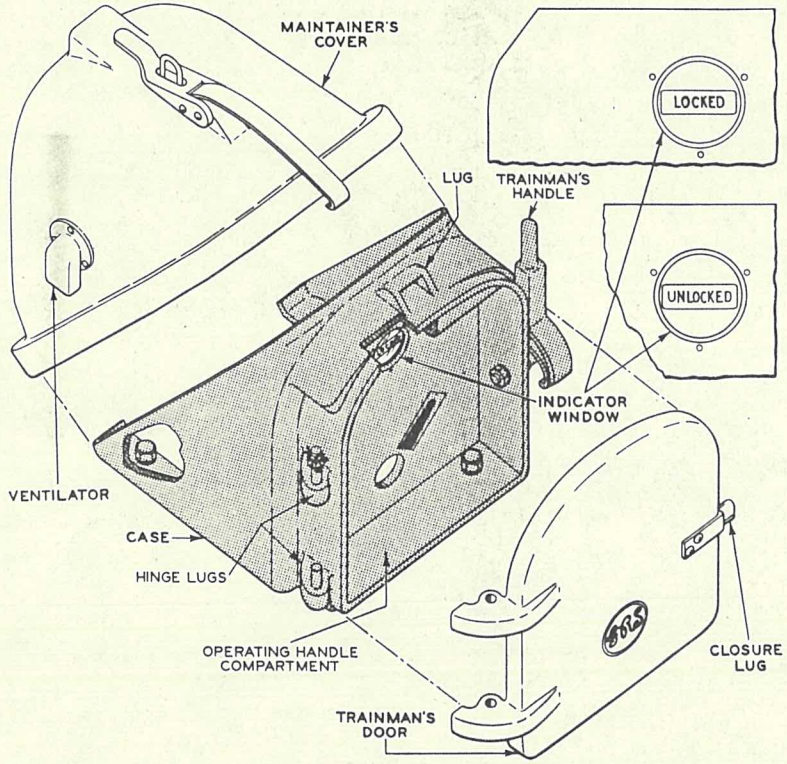


Figure 7. The cast iron case carries the maintainer's cover and the trainman's door.

Hinge lugs are cast on the left-hand side of the case for the trainman's door. The trainman's handle is on the right-hand side. A lug is cast on top of the case for the latch strap on the maintainer's cover.

Indicators

The banner indicator, Figure 8, is operated by the locking key through a push rod which has a spring to take up any overtravel. Near the lower end of the push rod is a collar which supports the push rod free of the locking key until the locking key has started to rise. This relieves the armature of any load in the deenergized position. When the key is lifted, the push rod elevates the metal banner to show the word UNLOCKED through the window in the partition, Figure 7. On locks having the banner type indicator, it is necessary to operate the handle through a preliminary movement of approximately 42 degrees to the intermediate position to permit the armature to pick up and actuate the indicator.

A light indicator, also shown in Figure 8, can be furnished instead of the banner indicator. The light indicator provides a visual indication without requiring the operation of the handle through the preliminary movement. The lamp

is spring mounted to withstand shock and vibration. Directly under the lamp socket is an insulated stop, which prevents the springs from being distorted when replacing the lamp. Either indicator is attached at the same location on the lock - directly above the locking key.

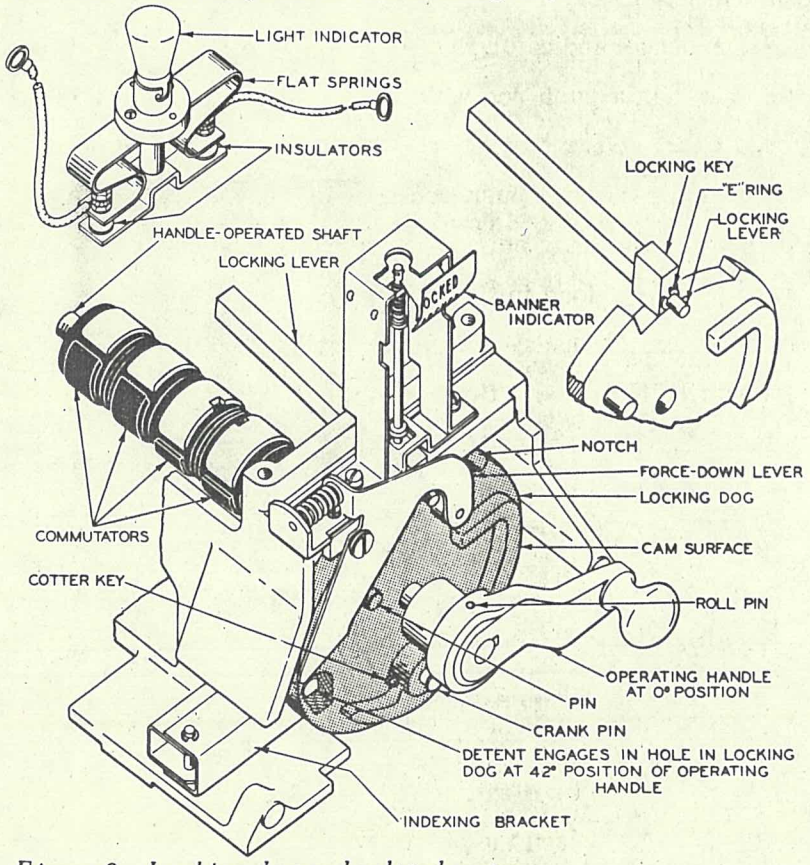


Figure 8. Locking dog and related parts.

Handle-Operated Contacts

Four handle-operated adjustable contacts, Figure 8, can be adjusted to make or break in any position of the 180-degree throw of the handle. Usually, they are adjusted so that two are closed in the normal position of the handle and the other two close at the intermediate position. These commutators are molded with a circle of rectangular openings 12 degrees apart on one side only as shown in Figure 25, page 44. A studded washer placed between each two commutators, has a key which fits into a keyway in the shaft. Because the commutators are engaged on the studs of this washer they are turned by the movement of the shaft.

Accessories

Pushbutton - An auxiliary pushbutton, Figure 9A, having either one normally closed, one normally open or one normally closed and one normally open contact can be provided for mounting on the case partition.

Door Circuit Controller - A door circuit controller, Figure 9B, with relay type contacts can be provided for mounting on the case partition. Door circuit controllers are available with one independent normally open and one independent normally closed contact or with two independent

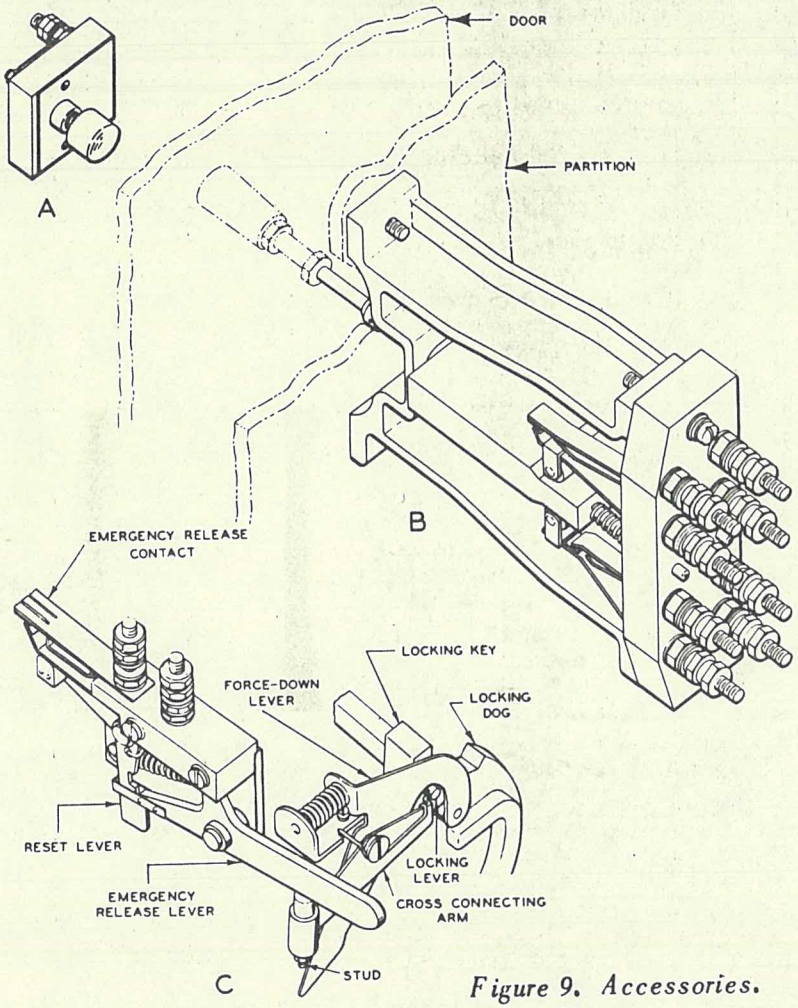


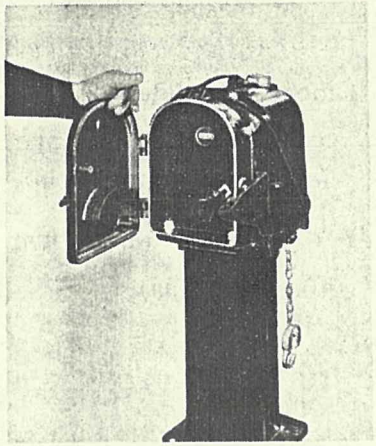
Figure 9. Accessories.
A - pushbutton
B - Door circuit controller.
C - Emergency release.

normally open and two independent normally closed contacts.

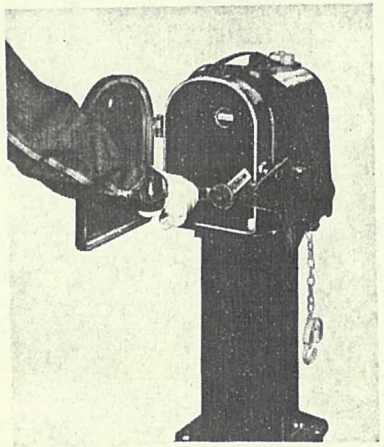
Emergency Release - The lever-operated emergency release of the latch-out type, Figure 9C, fits on the left-hand side of the frame near the force-down lever. The release is equipped with one normally closed contact and is sealed with a wire seal.

OPERATIONAL SUMMARY

1. *Remove padlock and open the door.*



2. *Move operating handle to the intermediate position (as far as it will go) and wait for banner to show UNLOCKED.*



3. *Move operating handle to the left as far as it will go. Plunger is now withdrawn from lock rod and switch may be thrown.*

4. *Return operating handle to normal position, close door and replace padlock.*

OPERATION

Operational Sequence (Normal Release)

Starting with the switch locked in its normal position the following text and Figures 10 through 16 will describe, step by step, the operation of the lock and the resulting action of the mechanism. See Figure 27, foldout, page 53, for references to the various parts of the mechanism. Preliminary unlock position - The padlock must be removed before the trainman's handle can be operated to open the door. A heavy flat spring, Figure 27C, holds the door closed tightly, since it engages the door lug when the trainman's handle is in its upright position. As the trainman's handle is swung forward and down, Figure 10, the spring is released and the cam forces the door open, even if it should be frozen shut. The operating handle, Figure 27A, is then raised to the intermediate position. A spring-loaded catch on the indexing bracket engages a detent on the locking dog at the intermediate position, thus holding the handle and locking dog in this position.

This initial movement of the operating handle moves the handle operated shaft, Figure 27A, and its associated commutators 42-degrees. These commutators may be set to

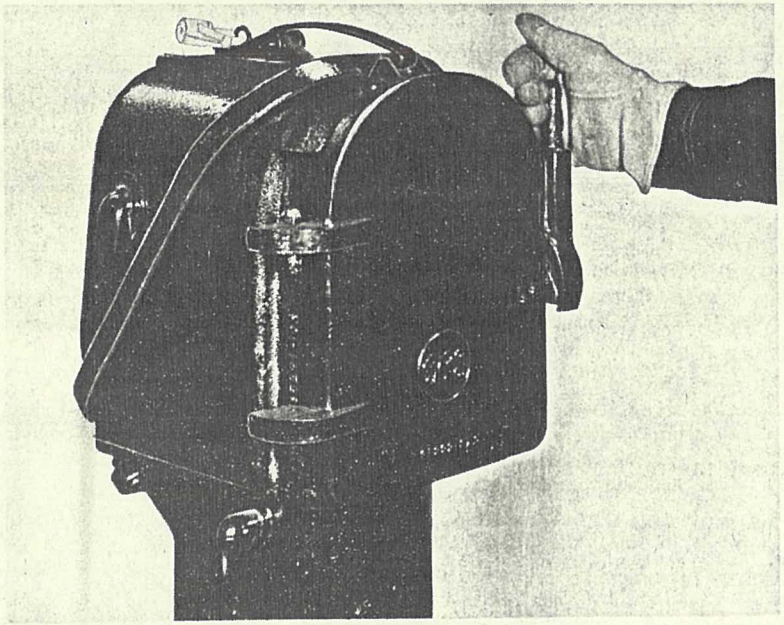


Figure 10. Pulling handle down to open door.

break the signal circuits taken through them so that the preliminary movement of the operating handle will set the signals to stop.

Further movement of the operating handle much beyond the detent position is prevented because the notch in the locking dog would engage the locking key. The detent holds locking dog free of actual contact with locking key so locking lever with key is free to pick up whenever the coils are energized. See Figure 27B.

The banner indicator in its down position shows LOCKED through the indicator window. A collar on the push rod rests on the base of the indicator frame.

Unlock Position

With the operating handle in the intermediate position, Figure 11, the lock is still effective because the locking

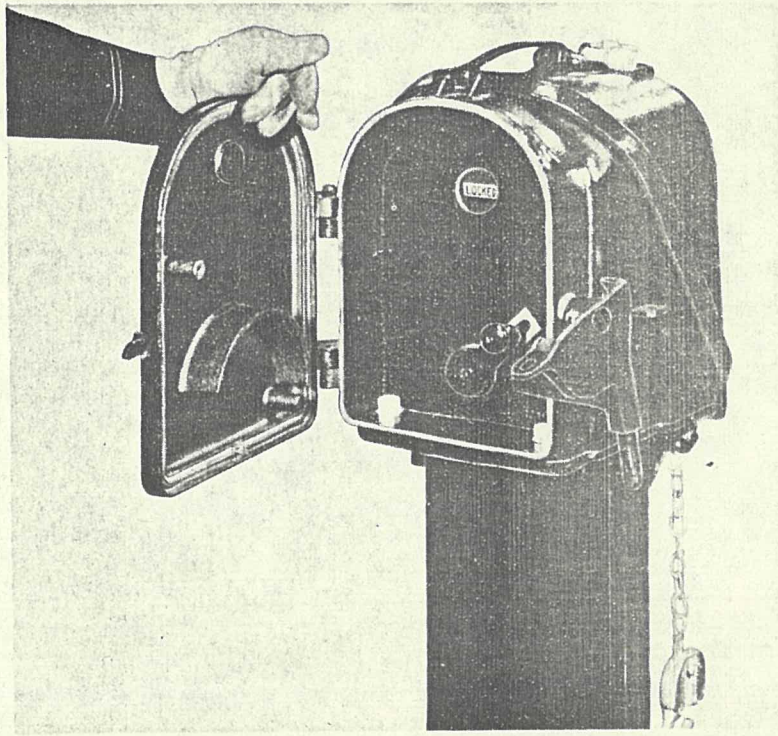


Figure 11. Waiting for unlock with operating handle raised to intermediate position.

key rests in the notch preventing further movement of the operating handle.

When the control circuit is energized,the armature, Figure 27B, is attracted to the pole pieces and raises its attached locking lever and key to clear notch on the locking dog. As locking key raises, it comes up under the push rod

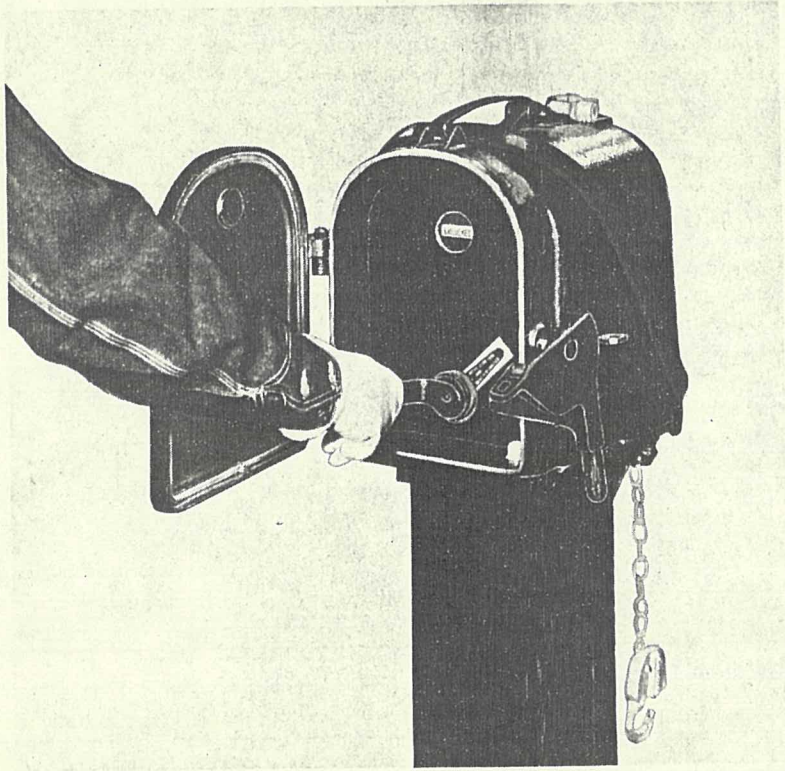


Figure 12. Operating handle rotated to the reverse position.

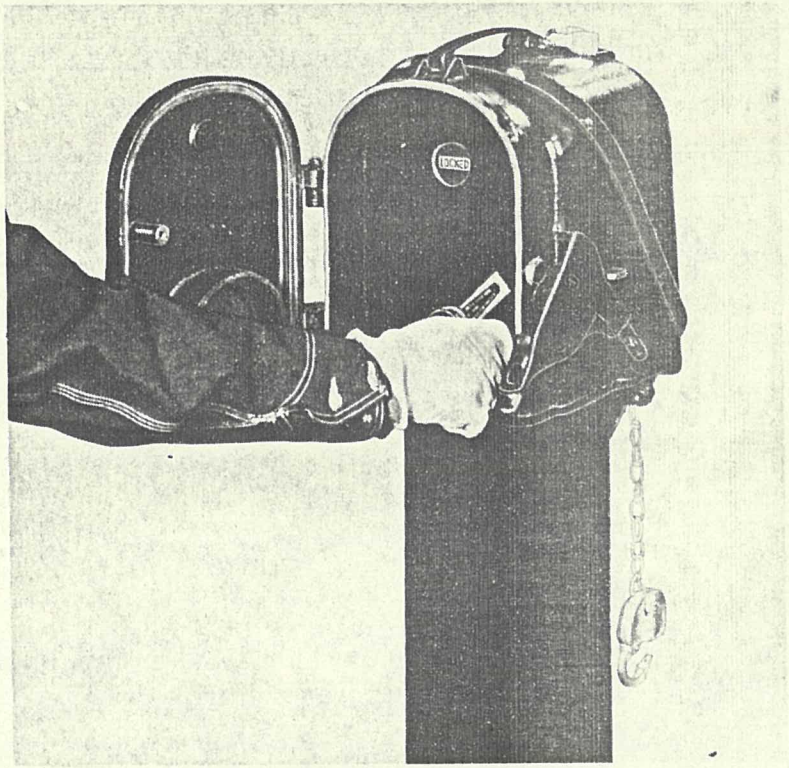


Figure 13. Operating handle returned to normal position.

which actuates the banner indicator. Any overtravel by the push rod is taken up by a coil spring underneath the banner indicator. Thus when the locking key picks up, the banner indicator moves to show the word UNLOCKED through the indicator window. With locking dog thus unlocked it is free to be rotated further by the operating handle, Figure 12.

As the operating handle is rotated to the reverse position, it carries with it the locking dog to which is attached the operating rod through the crank pin. In the normal position of the operating handle, the locking dog is at rest with its yoke or offset portion, Figure 27B, at its lowest point.

The operating rod is fastened to the locking dog by a pin, so when handle moves, the operating rod moves also. As the operating handle is rotated from the normal to the reverse position, the operating rod is raised, bringing the plunger with it. By the time the operating handle has reached the reverse position the plunger has been completely withdrawn from its hole in the lock rod, thus permitting the switch to be thrown.

Relock position - Before the trainman can lock up the mechanism, it will be necessary to restore the switch to its normal position. Otherwise the hole in lock rod will not be aligned with the plunger, and it will be impossible to restore the operating handle to its normal position. If lock rod is drilled for both normal and reverse locking, switch can, of course, be locked in either position and door closed.

A semi-circular lug, cast on the inside of the trainman's door, Figure 11, prevents the door from being closed until

the operating handle is in the normal position. Only then can the door be latched and the padlock applied, Figures 14, 15 and 16.

As the operating handle is returned to normal, Figure 13, locking dog and commutators are rotated through 180 degrees. As soon as locking dog reaches the intermediate position, the locking key is free to drop into notch on the

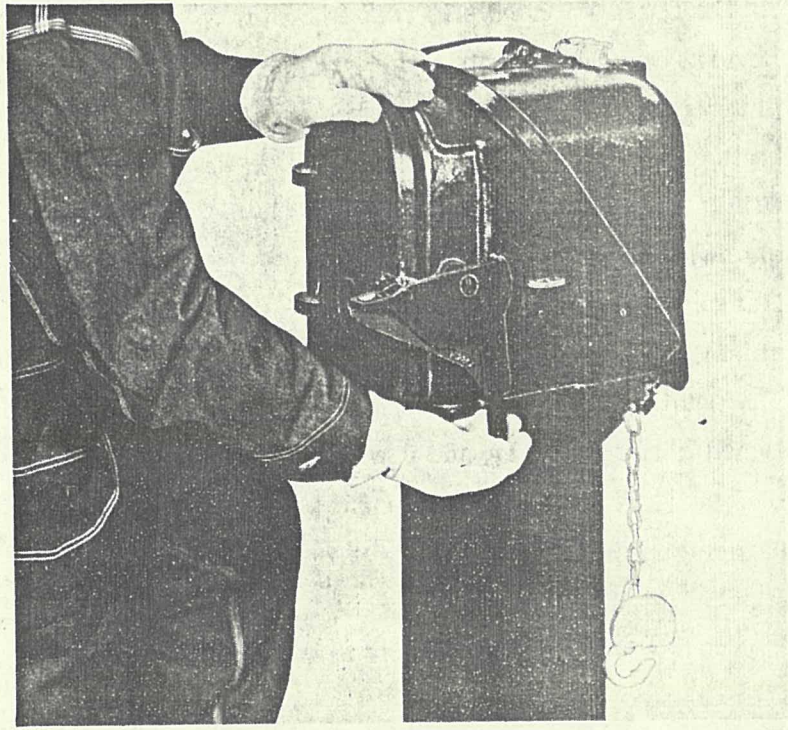


Figure 14. Closing trainman's door.

locking dog. At this point the lock is again effective unless energy is holding up the armature. As soon as the locking key drops into the notch, the banner indicator drops to show the word LOCKED through the indicator window, Figure 13. During the travel of the operating handle from the intermediate position to the normal position, the force-down lever

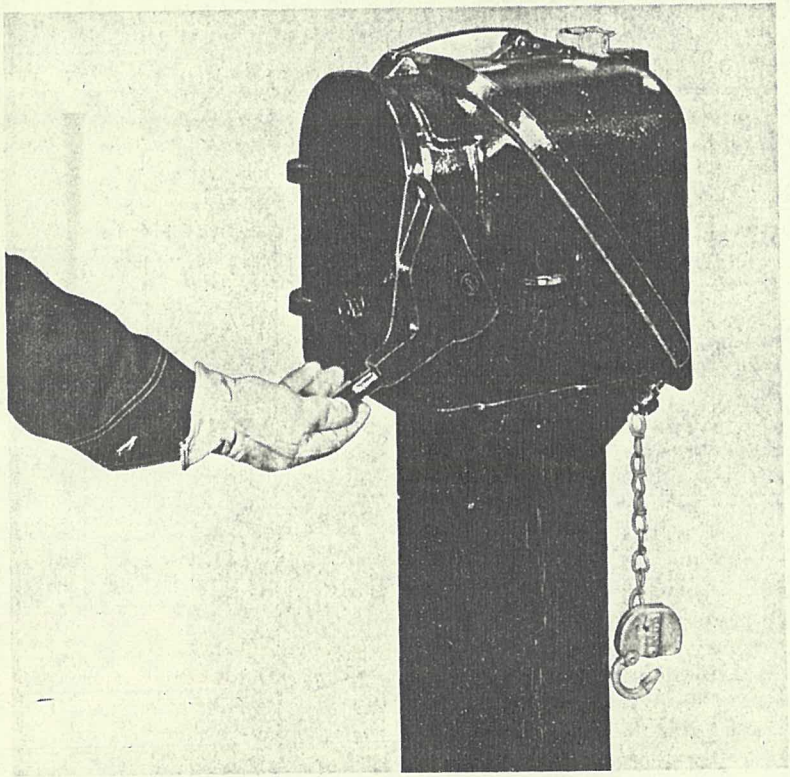


Figure 15. Returning handle to normal position.

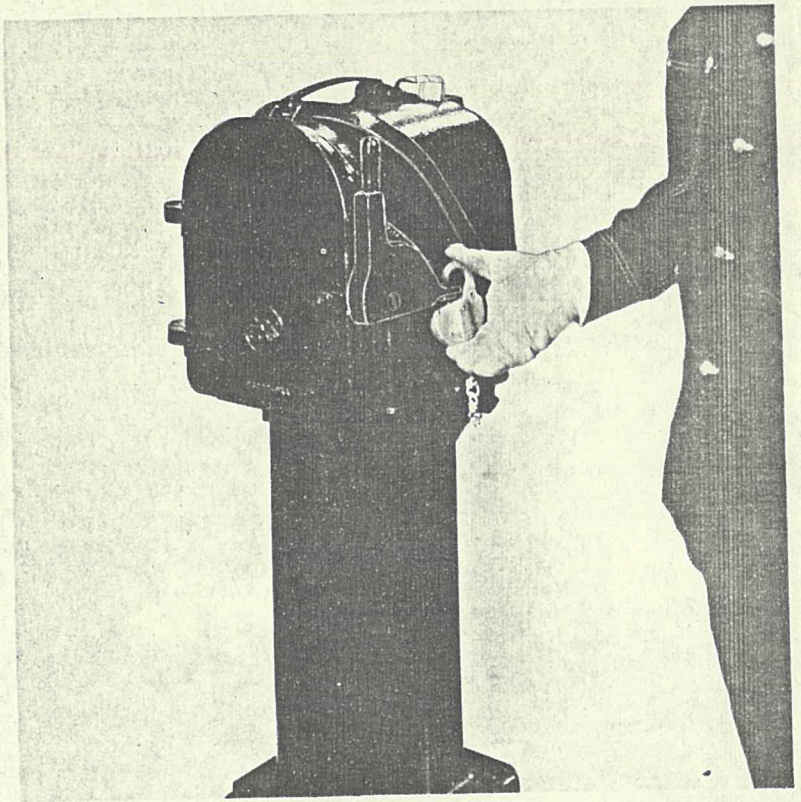


Figure 16. Closing padlock.

comes into play to ensure that the locking key is forced down into its notch on the locking dog.

Force-down operation - The "forced drop" feature consists of a pivoted, goose-necked force-down lever, Figure 27A. A roller on the goosenecked end of the lever engages a cam

on the face of the locking dog. Until the handle is in the intermediate position, a pin on the left side of the locking dog prevents the lever from rising to allow the locking key to lift out of the notch. As the operating handle is raised to the intermediate position, the roller on the force-down lever engages the cam on the face of the locking dog and lifts enough to allow the locking key to clear the notch in the dog. At the same time, the pin on the left face of the locking dog has moved down to clear the tapered portion of the force-down lever, thus releasing it just before the roller engages the cam and starts to lift the lever. When the armature is pulled up by the magnetic force of the energized coils, the force-down lever is already up to allow key to be raised out of the notch.

Operation of Emergency Release

Assuming that the normal control circuit does not respond and that the switch must be unlocked and operated for emergency reasons, the emergency release (an accessory) would be used. See Figure 9C, page 16, also Figure 17.

The operation of the switch lock would be the same as previously described except that the unlock would not be

obtained electrically with the operating handle at the intermediate position.

Break the seal on the emergency release, Figure 17. The sealing strap under the emergency release lever must be pulled forward out of the way before the emergency release lever can be pushed down to release the locking key through a cross-connecting arm.

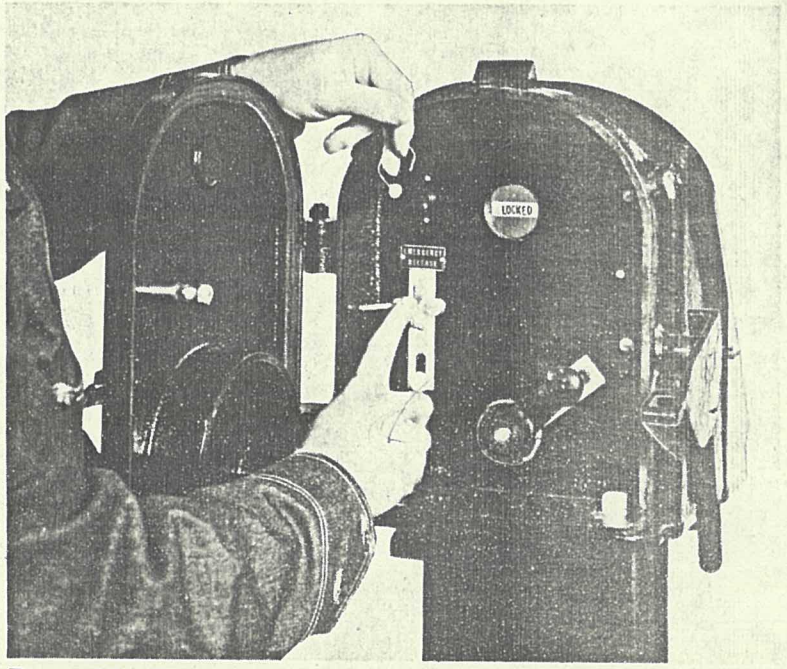


Figure 17. To use emergency release, operate handle to intermediate position, remove seal, hold down emergency release lever, and move operating handle to unlock position.

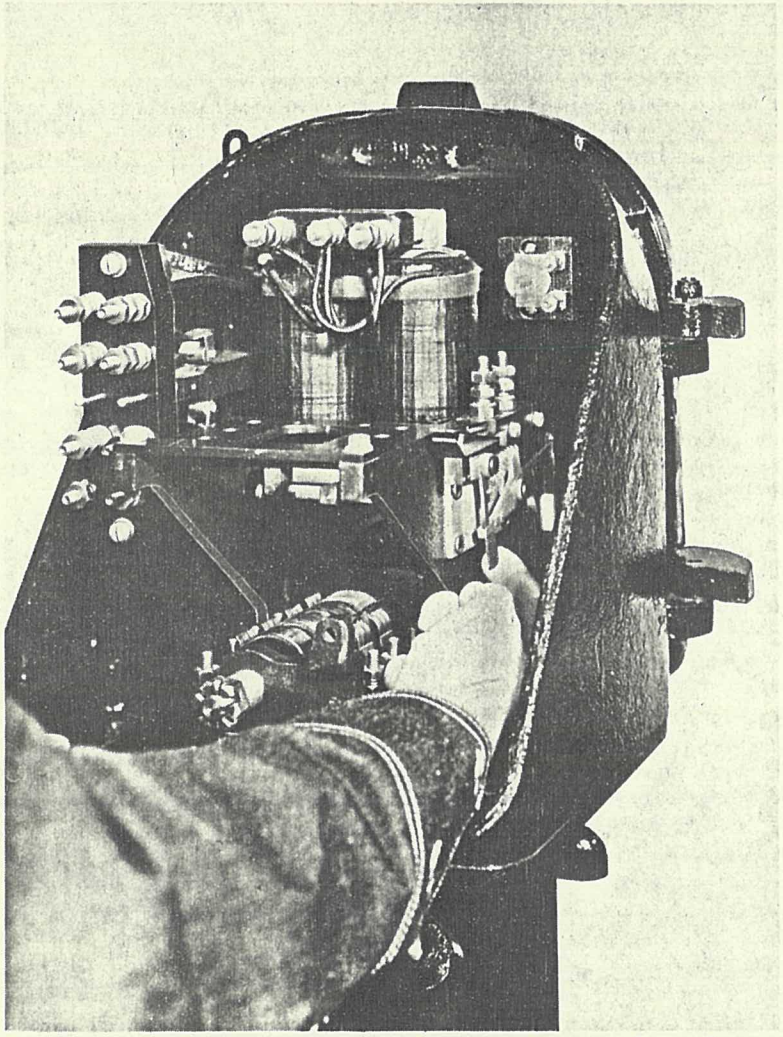


Figure 18. To reset emergency release, pull reset lever forward as shown.

Now the trainman can operate the lock in the normal manner except that he must hold the emergency release lever down until the operating handle is turned a few degrees beyond the intermediate position.

The emergency release, being of the latch-out type, cannot be reset except as illustrated in Figure 18. When the emergency release lever is pressed down, the reset lever, which is spring loaded, snaps its notched portion over the tapered end of the emergency release lever and holds the lever down until it is reset. The emergency release contact is opened when the reset lever snaps its notch over the end of the emergency release lever. The contact does not close until the release is reset. The emergency release lever cannot be resealed until it is reset.

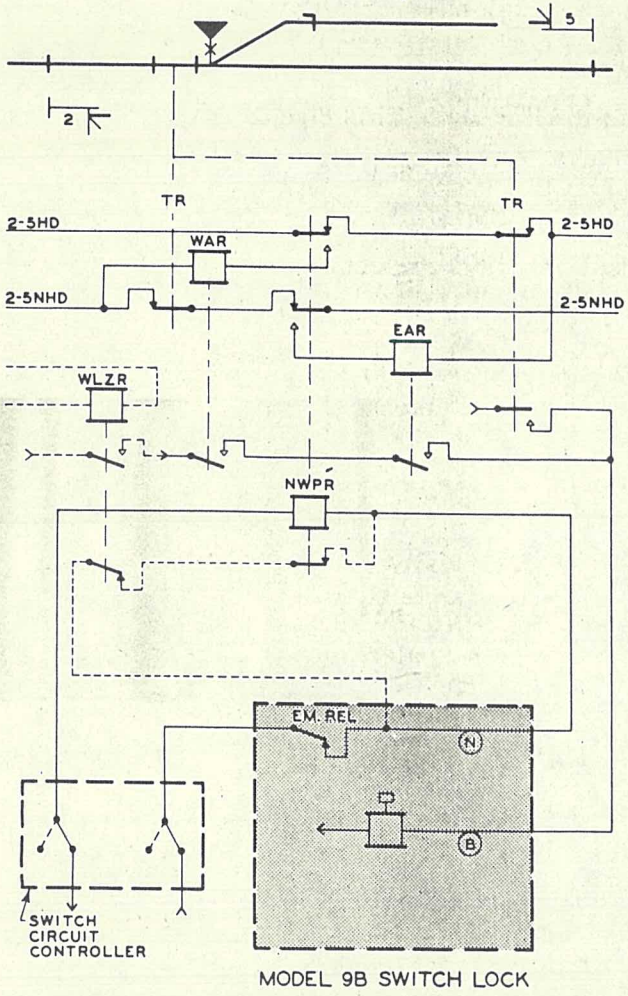


Figure 19. Typical switch-lock control circuit with emergency release and normally deenergized approach relays. Broken lines show optional supervisory control.

CIRCUITS

Figure 19 shows an arrangement having normally de-energized AR relays. This circuit is suitable for use on a two-, three-, or four-wire signal system (2-wire shown) with or without supervisory control.

Since AR relays are connected to the line through back contacts on the NWPR relay, the signal circuits will be opened by the preliminary movement of the operating handle. When supervisory control is used, the signal circuits will not be opened unless the supervisory control relay (WLZR) is energized and the operating handle is moved to the intermediate position.

The circuit as shown uses the mechanical emergency release. A short track circuit is used to release the lock for a train leaving the main line. An indication, if required, may be taken from the NWPR relay.

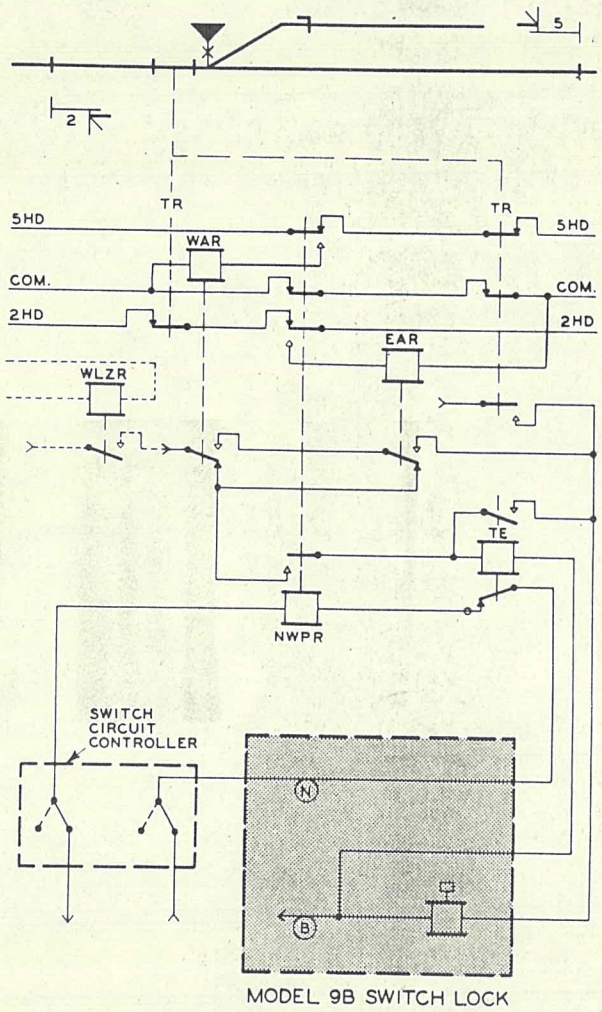


Figure 20. Typical switch-lock control circuit with time release and normally deenergized approach relays. Broken lines show optional supervisory control. Preliminary movement of crank will slot signals.

Figure 20 shows an arrangement having normally deenergized AR relays. This circuit is suitable for use on a two-, three-, or four-wire signal system (3-wire shown).

The preliminary movement of the crank will open the signal controls, dropping the NWPR relay. The circuit can be used either with or without supervisory control. The circuit is shown with an automatic electrical time release. A short track circuit is used to release the lock for a train leaving the main line. An indication, if required, may be taken from the NWPR relay. The mechanical emergency release can be used in addition, if desired.

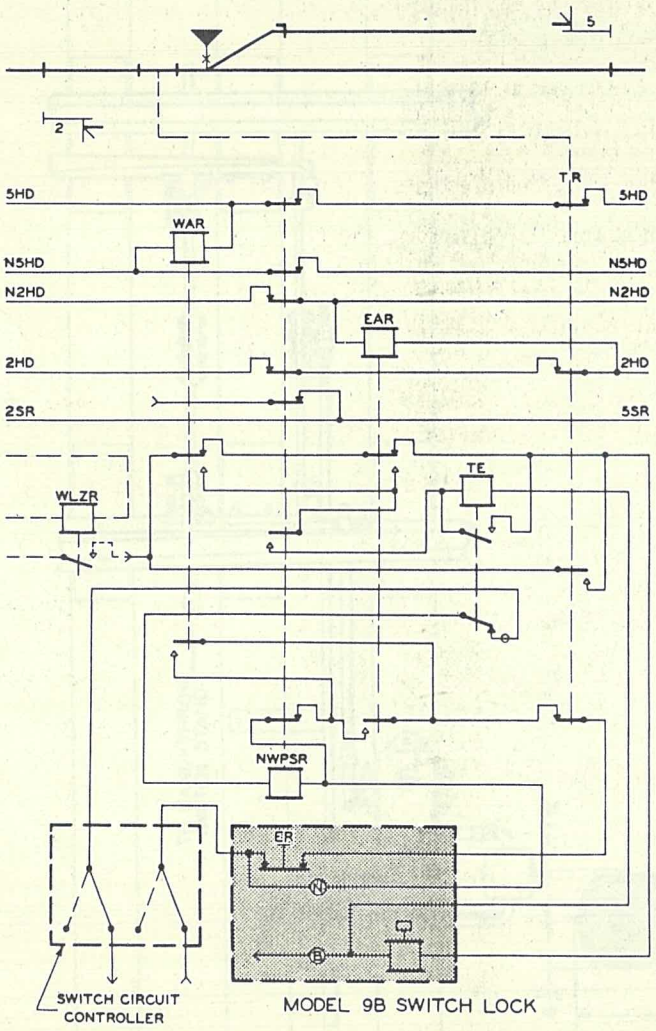


Figure 21. Typical switch-lock control circuit with pushbutton and normally energized approach relays. Broken lines show optional supervisory control.

Figure 21 shows an arrangement having normally energized WAR and EAR relays and is suitable for a four-wire signal system only. A feature of this circuit is that neither the energization of supervisory control nor the preliminary movement of the crank will slot the signals if a train is approaching the location. The circuit as shown contains a time relay which will release the locking after a predetermined time interval, if either approach is occupied. Timing will not start until after the deliberate operation of the ER pushbutton in the lock, which will drop the NWPSR and slot the signals. A short track circuit is used to release the lock for a train leaving the main line. If desired, this can be made dependent upon the supervisory control. If an indication is required in the case of supervisory control, it may be taken from the NWPSR relay.

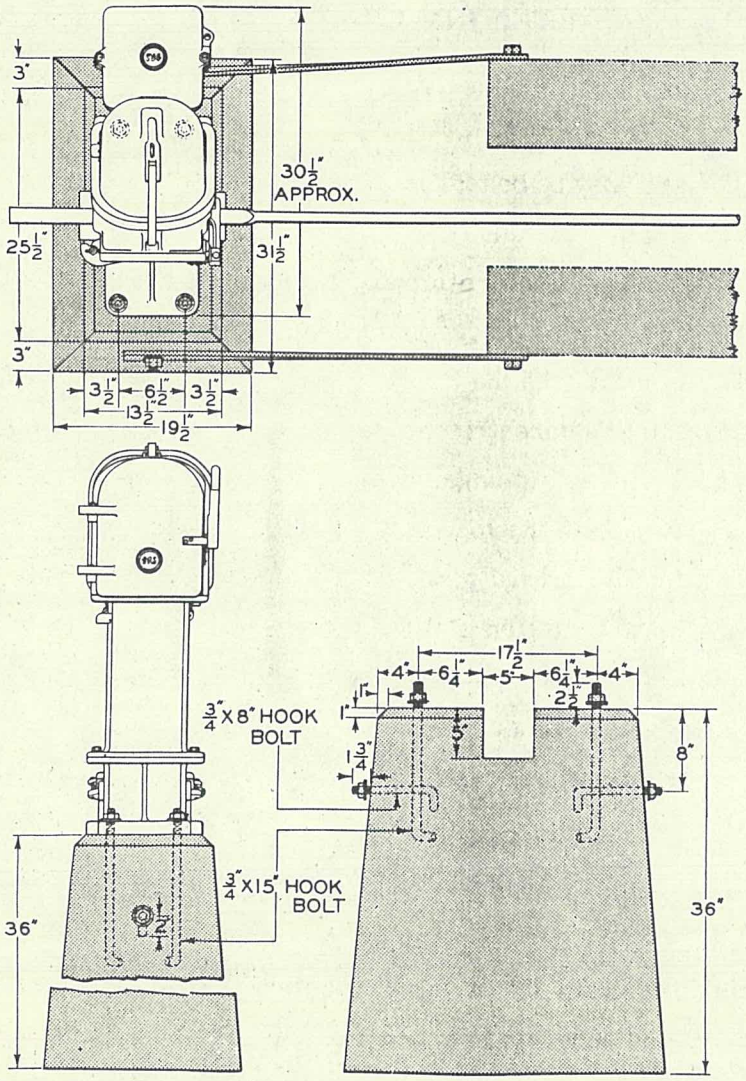


Figure 23. Concrete foundation mounting.

is recommended only where the lock is mounted on a concrete foundation. A form should be made for the concrete foundation following the dimensions given in Figure 23. The hook bolts must be inserted before the concrete is poured. Care must be taken when the foundation is positioned that there will be unrestricted movement of the lock rod in its slot. Here also, the clearance dimensions will have to be determined by the individual requirements of the railroad. See that the locking plunger drops freely into the hole in the lock rod when the lock is positioned on the foundation with the switch in its normal position.

Wiring Information

Wire may be brought in through a cable entrance adapter screwed into the 1-1/2" pipe threads on the wire entrance plate, or if the lock has a junction box the cable may be terminated there. Wires are run up that part of the pedestal which is closer to the wire entrance and directly under the circuit controller. Wires may be run without removing the case, or the case can be removed without disturbing the mechanism. Wires should be divided and so placed that those attaching to left-hand terminal posts will come up that side of the pedestal, etc.

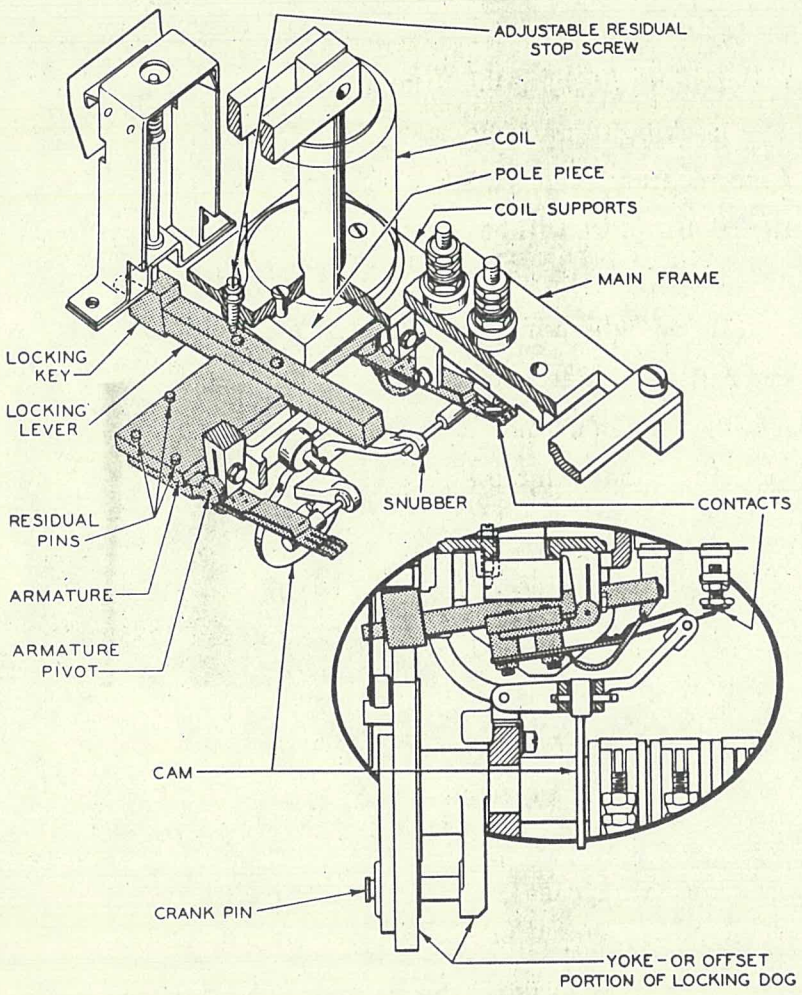


Figure 24. Parts of mechanism cut away to show armature assembly and related parts.

MAINTENANCE

Lubrication

Lubricate lock plunger with grease as needed through the pressure fitting in base of post. Other bearings are so constructed that they will not require lubrication.

Armature (Figure 24, page 42)

Armature end play shall not be less than 0.010" nor more than 0.020". This adjustment shall be made so the locking load on locking key is not transmitted to the armature trunnions.

The adjustable residual stop screw shall be adjusted and locked to give 0.015" parallel armature air gap.

When the locking key is in the full released position (picked up) it shall clear the top of the dog on the operating shaft by at least 0.010". The following adjustments should be checked with operating handle in intermediate position. Back Contacts - Both contacts shall make and break within 0.005" of each other. When fully made the finger shall be 0.020" to 0.025" from its front stop. Trapped pressure shall be 25 to 35 grams. Contact resistance shall not exceed 0.02 ohm each.

Contact Opening - Shall not be less than 0.050".

Back Contact Snubber (Figure 24, page 42) - After back contacts have been completely adjusted as described under the preceding heading "Back Contacts", the snubber shall be adjusted so that with operating handle in full normal position the clearance between back contact finger and its stop is 0.005" to 0.010" less than the adjustment made under "Back Contacts".

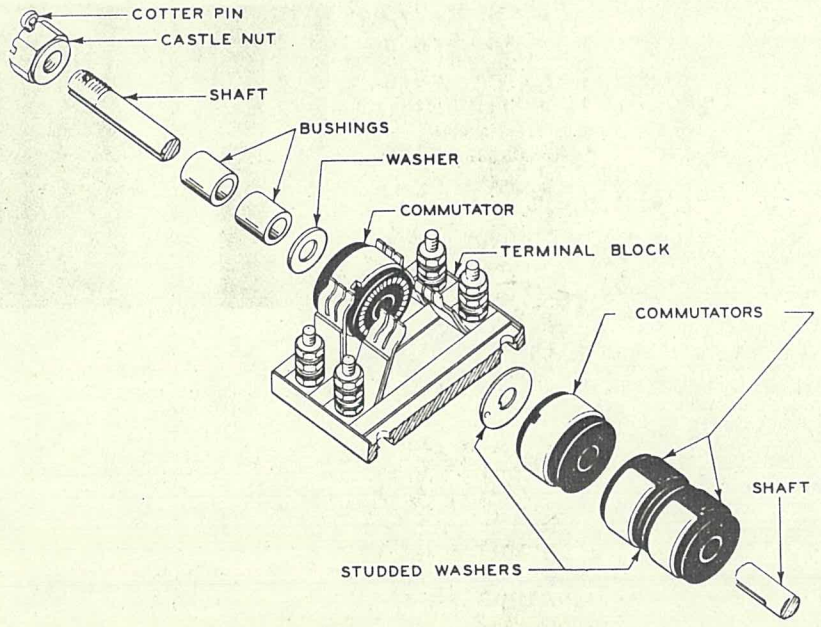


Figure 25. Exploded view of commutator assembly.

Commutators (Figure 25, page 44)

Commutators shall be adjusted so contacts will make and break as required. Each of the 3 tips on the contact spring shall be adjusted to make contact for as much of its full width as practical and each shall exert pressure of 5 to 9 oz. against the contact band on commutator, measured as near the point of contact as possible. The variation in this pressure shall not exceed 2 oz. between tips on the same contact spring. The contact spring shall not overhang the bands on commutators by more than 1/32".

Contact adjustment is made by loosening the nut at the end of the commutator shaft and sliding the bushings back enough to disengage the commutator from the studded washer. Shift the commutators to the desired position and put them back in contact with the studded washers. Do this two at a time, starting from the back. Replace the outside washer and bushings. Tighten the nut till the whole assembly is snug; then replace cotter pin.

Banner Indicator (Figures 8, page 14, and 24, page 42)

All movable parts shall operate freely. When operating handle is in full normal position, the banner arm must rest on the stop pin. When operating handle is in the full reverse

position and locking key is in the full released position, the banner arm must rest against the top of mounting bracket. The banner shall clear the bezel and drive screws for bezel by at least 1/32".

Accessories

Emergency Release (Figure 9C, page 16)

1. With the operating handle in the normal position and the emergency release lever in the notch, tripped, with contact opened, adjust stud so cross-connecting arm will just clear the end of locking lever.
2. With operating handle and emergency release lever both in the normal position, the clearance between the cross-connecting arm and the end of locking lever must not be less than 3/16".
3. With the operating handle in the intermediate position and the emergency release lever held all the way down, the locking key must be raised far enough to release the lock.
4. With lock energized and conditions as in paragraph (3) above, there must be a clearance between the cross-connecting arm and end of locking finger.

5. The emergency release lever shall not bind against any part of the lock case.
6. With sealing strap on case in position for sealing, it shall not be possible to operate the emergency release lever far enough to open the contact.

Push Button (Figure 9A, page 16)

1. For normally OPEN push buttons: Contacts to be adjusted so that when button is operated they will follow the disc 1/16".
2. For normally CLOSED push buttons: Contacts to be adjusted so that when button is operated they will follow the disc 1/32".

Door-Operated Circuit Controller (Figure 9B, page 16)

Contact opening not to be less than 0.050". Contact pressure to be from 8 to 16 ozs. Contact finger to be from 0.010" to 0.015" away from its stop with contact closed.

Cover (Figure 26, page 48)

The cover fit can be adjusted as follows: Remove cotter pin in hinge pin on cover. Remove cover from lock. Loosen jam nuts at bottom of eyebolts and screw eyebolts in until cover can be closed with even pressure all around. Each eyebolt should be adjusted the same. Hold eyebolts straight

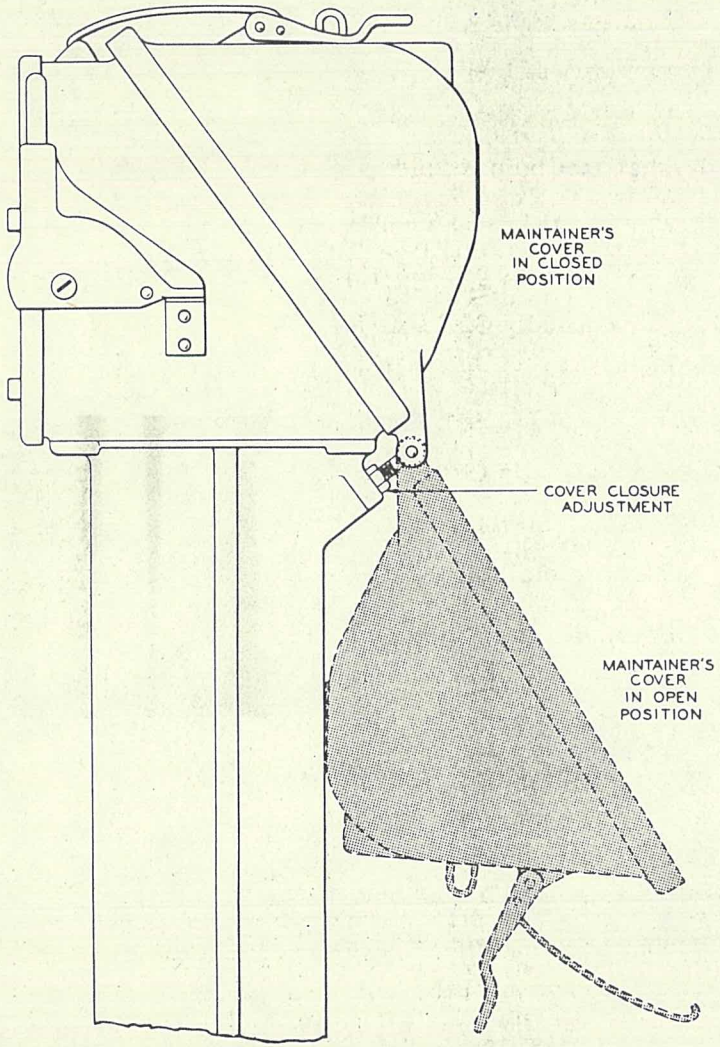


Figure 26. The maintainer's cover swings down out of the way providing easy access to the mechanism.

and tighten jam nuts. Reinstall cover and replace cotter pin. Make sure that eyebolts do not put excessive pressure on the hinge pins.

Removing Mechanism (Figure 8, page 14)

1. Remove case as follows:
   a. Drive out roll pin holding operating handle to shaft.
   b. Remove operating handle and felt washers from shaft.
   c. Remove four cap screws, and lift off case.
2. Remove cotter key holding crank pin in operating rod and locking dog.
3. Remove crank pin holding operating rod in yoke section of locking dog.
4. Remove 4 cap screws and lift out mechanism.

Operating Values

Resistance of Lock	Minimum Dropaway	Working Current Max.	Normal Voltage
OHMS	AMPS	AMPS	VOLTS
16	0.0091	0.091	2
200	0.0030	0.030	8
306	0.0024	0.024	10
300	0.0024	0.027	10
400	0.0024	0.024	12

A-c. Operation

To operate a lock from 110 volt supply, either 60 cycle or 25 cycle, order a 10-volt lock with a BQ 1/2 rectifier as follows:

Volts (A.C.)	BQ 1/2 Rectifier Ordering Ref.
110 volts, 60 cycles	Plate P1787 Figure B5
110 volts, 25 cycles	Plate P1787 Figure B6

MODELS 9C AND 9D LOCKS

Models 9C and 9D locks are also available when specified. These are both basically the same as the Model 9B lock. The same choice of options and accessories is available for these locks.

Model 9C Lock

The main difference is in the mechanism. The Model 9C electromechanical switch lock has a mechanical clockwork time release in addition to the same electrical release as in the Model 9B lock. This clockwork time release may be set to trip the lock lever in from 1 to 8 minutes.

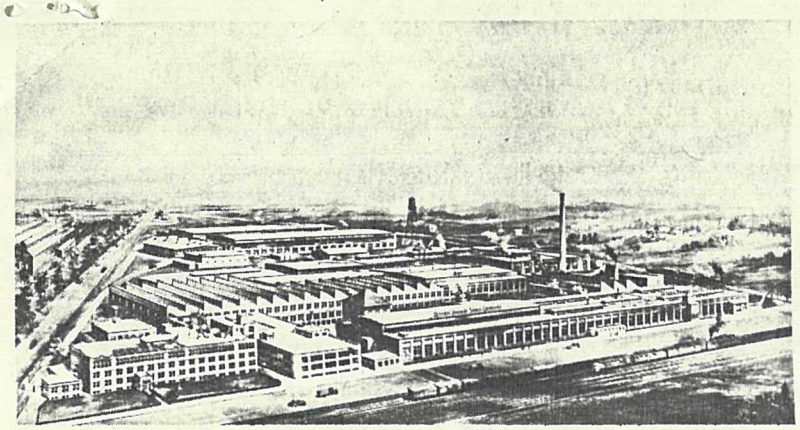
Model 9D Lock

The Model 9D mechanical time switch lock has only the clockwork time release. There are no coils in this lock.

Note: No attempt should be made to repair the clockwork time release. If defective it should be returned to the factory.

ORDERING INFORMATION

See G-R-S Catalog Section K, Part 2, to order parts or complete locks.



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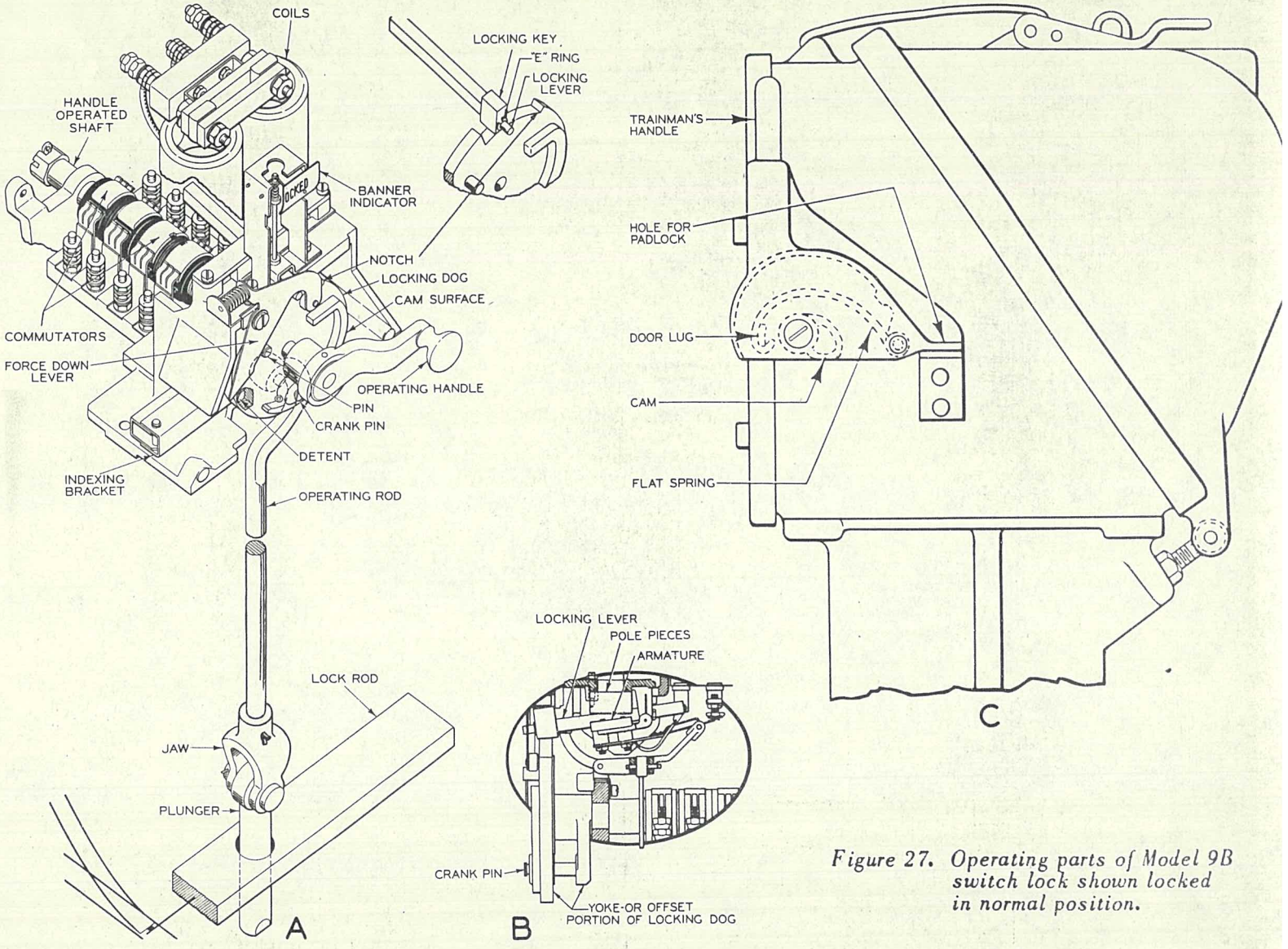
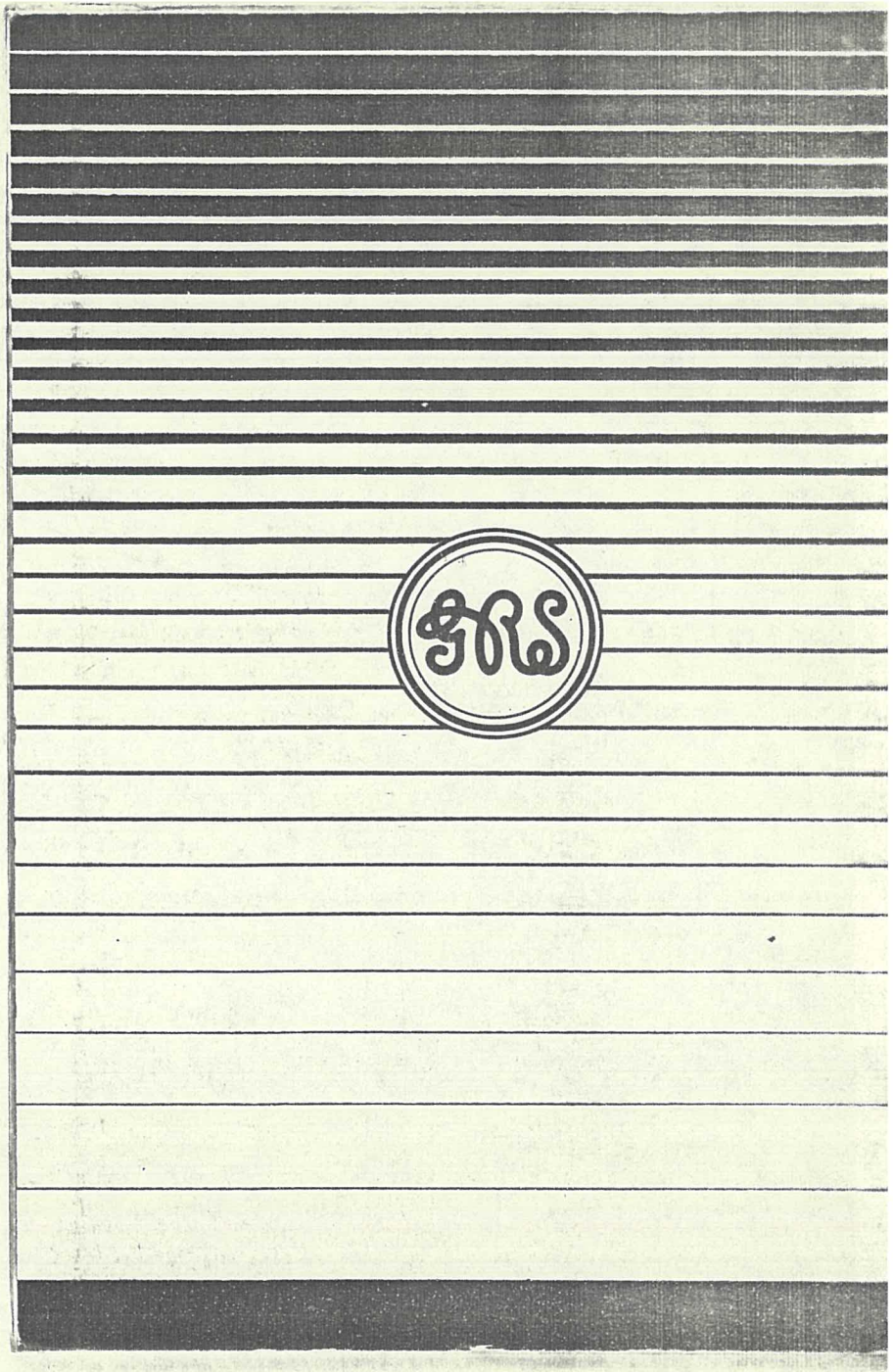


Figure 27. Operating parts of Model 9B switch lock shown locked in normal position.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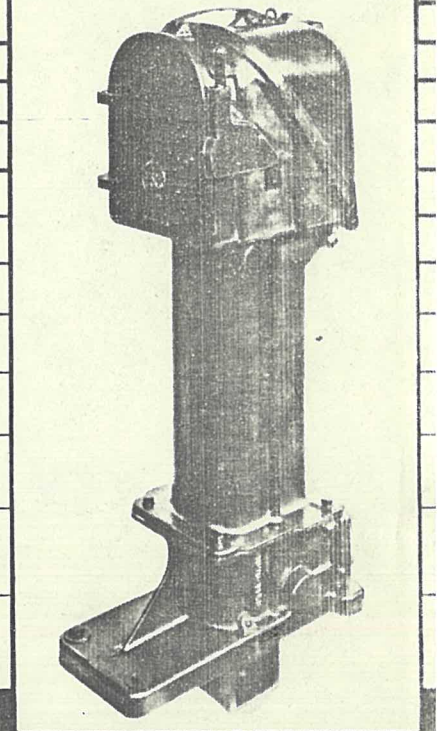
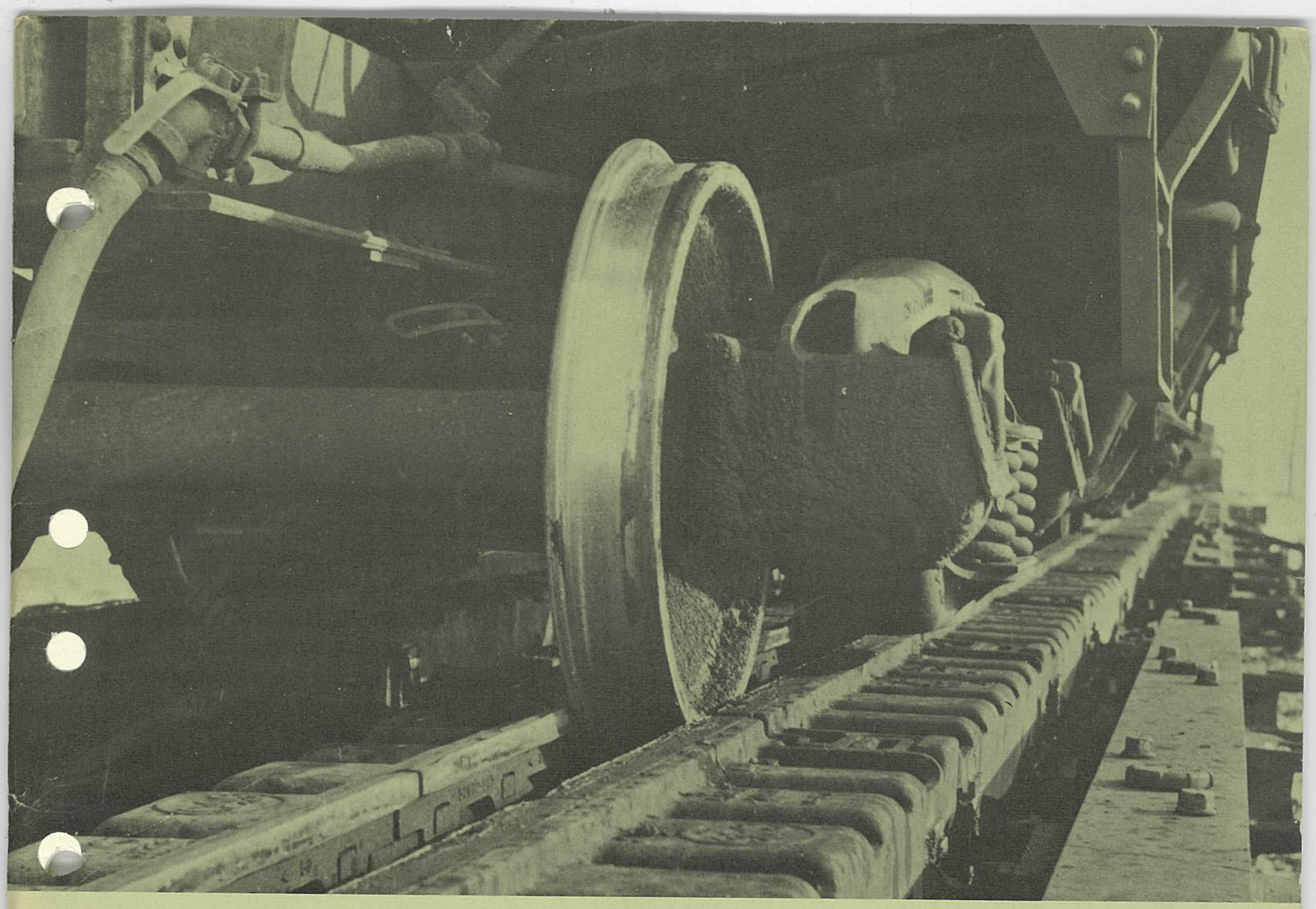
RG 5/23

G·R·S Model 9B Electric SWITCH LOCK



HANDBOOK
52



GRS TYPE E160 ELECTRIC CAR RETARDER

Precision control for free-rolling cars . . . up to 160 tons

GENERAL RAILWAY SIGNAL COMPANY
A UNIT OF GENERAL SIGNAL CORPORATION

GRS DEVELOPMENT D99.0701

E160 VELOCITY HEAD RATINGS

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Total Length of Retarder in Feet	Number of Effective Beams	Number of Mechanisms	100-Ton 4-Axle Cars with 33" Wheels .655' V.H. per Effective Beam	160-Ton 4-Axle Cars with 38" Wheels .420' V.H. per Effective Beam
16-1/2	2	1	1.31	0.84
22	3	1	1.96	1.26
27-1/2	4	1	2.62	1.68
33	5	1	3.27	2.10
38-1/2	6	1	3.93	2.52
44	7	1	4.58	2.94
49-1/2	8	1	5.24	3.36
55	9	2	5.89	3.78
60-1/2	10	2	6.55	4.20
66	11	2	7.20	4.62
71-1/2	12	2	7.86	5.04
77	13	2	8.51	5.46
82-1/2	14	2	9.17	5.88
88	15	2	9.82	6.30
93-1/2	16	2	10.48	6.72
99	17	3	11.13	7.14
104-1/2	18	3	11.79	7.56
110	19	3	12.44	7.98
115-1/2	20	3	13.10	8.40
121	21	3	13.75	8.82
126-1/2	22	3	14.41	9.24
132	23	3	15.06	9.66
137-1/2	24	3	15.72	10.08
143	25	4	16.37	10.50
148-1/2	26	4	17.03	10.92
154	27	4	17.68	11.34
159-1/2	28	4	18.34	11.76
165	29	4	18.99	12.18
170-1/2	30	4	19.65	12.60
176	31	4	20.30	13.02
181-1/2	32	4	20.96	13.44
187	33	5	21.61	13.86
192-1/2	34	5	22.27	14.28
198	35	5	22.92	14.70
203-1/2	36	5	23.58	15.12
209	37	5	24.23	15.54
214-1/2	38	5	24.89	15.96
220	39	5	25.54	16.38
225-1/2	40	5	26.20	16.80
231	41	6	26.85	17.22
236-1/2	42	6	27.51	17.64
242	43	6	28.16	18.06
247-1/2	44	6	28.82	18.48
253	45	6	29.47	18.90
258-1/2	46	6	30.13	19.34
264	47	6	30.78	19.74
269-1/2	48	6	31.44	20.16
275	49	7	32.09	20.58
280-1/2	50	7	32.75	21.00
286	51	7	33.40	21.42
291-1/2	52	7	34.06	21.84
297	53	7	34.71	22.26

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AUGUST 1967

GRS ELECTRIC CAR RETARDER

TYPES E, E1, E1H, E1HS and E160

INSTALLATION AND MAINTENANCE INSTRUCTIONS

INCLUDING HEAVY CAR CONVERSION

Supersedes Handbooks 48 and 82

GENERAL RAILWAY SIGNAL COMPANY
A UNIT OF GENERAL SIGNAL CORPORATION
ROCHESTER NEW YORK 14602

CONTENTS

PREFACE 3

PART I INSTALLATION

GENERAL 3
PREPARATION 3
RETARDER ASSEMBLY 4

PART II LUBRICATION

GENERAL 7
RETARDER 7
RETARDER MECHANISM 8
CONTACTOR PANEL 8

PART III PREVENTIVE MAINTENANCE

GENERAL 9
RETARDER 9
RETARDER MECHANISM 10
CONTACTOR PANEL 12

PART IV PARTS REPLACEMENT

GENERAL 12
RETARDER 12
RETARDER MECHANISM 14
CONTACTOR PANEL 16

PART V LOCATING TROUBLE

GENERAL 18
RETARDER 18
RETARDER MECHANISM 18
CONTACTOR PANEL 18

PART VI HEAVY CAR CONVERSION

GENERAL 18
RETARDER 18
RETARDER MECHANISM 19

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PREFACE

This publication describes the recommended procedures for properly installing and maintaining GRS Types E, E1, E1H, E1HS, and E160 electric car retarders, including their associated mechanisms and contactor panels. Also included are instructions for converting existing retarders to enable handling up to 160 ton cars.

As the car retarder is a hard-working device, a planned program of preventive maintenance is of the utmost importance. Experience has indicated that such a program improves operating efficiency, which, in turn, promotes better harmony and teamwork among personnel.

It is recommended that all maintenance personnel be assigned fixed duties and that periodic inspections be made to ensure that these duties are performed.

The latest engineering advancements have made the retarder as rugged as possible - with proper maintenance, long and dependable operation can be assured.

PART I

INSTALLATION

GENERAL

The following installation instructions for Types E, E1, E1H, E1HS, and E160 car retarders are general only. They are to be used as a guide, with reference to the special instructions provided with your installation. Figures 1 and 2 at the back of this publication are the assembly and layout drawings of the retarder; Figure 3 shows typical tie arrangements.

PREPARATION

1. Drill the rails in accordance with the rail drilling plan furnished with the special instructions for installation. The rails may be spliced at any chair location in the retarder.

2. Drill and frame the ties in accordance with the drawings furnished with the special instructions.

   Four kinds of ties are required: entering tie, leaving tie, beam tie, and mechanism tie. Quantities of each depend upon the length of the retarder. Where the retarder abuts an existing retarder, an entering tie is not used.

3. Retarder parts are supplied with a primer coat of paint. Apply a finish coat of paint to the parts before, or after, assembly.

4. During assembly, check that the retarder parts move without binding. If binding occurs and lubrication is not indicated, grind the part to obtain a proper fit.

5. During assembly, lubricate as follows with reference to the instructions in PART II LUBRICATION:

   a. Before installing, dip the threaded portion of all bolts, studs, and rods in heavy oil.

   b. Before the shoe beams are installed, paint the bearing surfaces of the chairs with graphite grease.

   c. Dip all pins in heavy oil, or cover with a coat of light grease.

   d. Grease the bearings equipped with hydraulic grease fittings after assembly. A large quantity of grease is required to fill all of the grease cavities in the large crank pivot pins; pump grease to the pins until it begins to overflow.

   e. Lubricate the following parts with heavy oil, graphite grease, or their equivalents (see Figure 1):

      - between the chairs and shoe beams.
      - articulated joints between the shoe beam and levers.
      - between the levers and fixed or floating bearings.
      - between the spring seats and levers.
      - spring rod threads.
      - bearings between the crank and cross bar.

- bearing between the bottom of the cross bar and spacer 21.

- at the top end of 3" crank pivot 39.

RETARDER ASSEMBLY

The A7-beam foundation layout for a 38'6" retarder is shown in Figure 1. Typical wood tie arrangements are shown in Figure 3. The operating lever combinations and mechanism location for each installation are shown in the heading of the group list accompanying the special instructions. Where convenient, assemble the intermediate and inert sections prior to installation on the track, as described in the following steps 1 through 10:

1. Attach steel beams 90 and 91 to the beam ties, Figure 2, using plates 95, rods 93, nuts 68 and 82, and washers 29. At the mechanism location, use two mechanism ties each paired with a beam tie. Two beam ties are required for each inert section.

2. Assemble the operating sections by installing main bearing 45 and spacers 72 (see Figure 1, section S-S) on steel beams 90 and 91. Make sure strap nuts 31 on top bolts 28 are in a horizontal plane to prevent interference with the shoe beams (see NOTE, step 29).

3. Lay the spring rods into all sections after backing off the nuts as far as possible without removing the lock nut. The rods with short springs 84 are used at inert sections (section T-T); the rods with long black springs 73 are used at all intermediate locations (section S-S). If a retarder is to handle empty cars only, see the special installation instructions for the assembly of springs 73 and 84.

4. Slip an operating crank 17 into the bearing in each cross bar 56 (section S-S).

5. Lay cross bars 56 into all operated sections and slip the "T" heads through the hole in bearing 45 and into the seat in cranks 17. Cross bars 56 can now be assembled with the spring stop arrangement at the far end of the bar. Referring to view at N, assemble spring 87, stop bracket 88, bolt 89, and collar nut 86 in the cast bracket welded to the cross bar. Tighten nut 86 so that cotter 85 just enters the hole in the bolt.

6. Install bridge brackets 62 using 2-1/2" bolts 61, lock washers 29, and strap nuts 31 (section S-S).

7. Insert lever bearings 65.

8. Place levers 74 on bearings 65 and also on the cross bar bearings and inert section bearings.

9. Hang spring assemblies 73 and 84 on levers 74 (sections T-T and S-S). Slip the rod in the spring seats so that first one seat and then the other can be seated on the levers.

   Tighten the large flange nut on the spring rod until all play is taken up in the assembly. Back off the nut at least three full turns to ensure there is no initial compression on the spring. Hold the flange nut and tighten the lock nut with the special ratchet-type socket wrench provided for these nuts. The ordering reference for this wrench can be found on Plate MO161 in the GRS Car Retarder Catalog.

   Wire levers 74 to prevent their moving off their seats and dropping the spring rod assemblies when the complete operated, or inert, section is moved into place.

10. Locate the operated and inert sections at proper 5'6" spacing, in proper alignment, and to approximate grade in the track.

11. Install angle bar 38 on bearings 45. Do not install bolts 46 (section X-X) until lower bearing bracket 48 is installed. Use hex nuts on bolts 78 (section S-S) under the angle bar at all locations, except at the mechanism ties where 5" strap nuts 79 are used.

12. Remove the slushing compound from crank pivot pins 26 and dip the pins in heavy oil or cover with light grease, as previously explained. Insert the pins (view at U) using the special screw handle device (see Plate MO161) provided with the installation. Apply heavy oil to the top end of each pin.

13. Assemble outside chairs 4 loosely in place before installing the rail. Lay rail in the retarder, referring to "Preparation", step 1.

14. Assemble inside chairs 5 on the retarder beams and bolt the rail to both the inside and outside chairs. Be sure that the chairs are located opposite to each other. Bolt the chairs to the steel ties with 1" x 2-3/4" bolts 60. Note that inside chairs 5 have elongated mounting holes where the chair bolts to the steel tie. Also note that track bolts 59 (section S-S) assemble with the nuts inside the rail. The chairs space the rails for approximately 56'-11/16" gauge. Tighten all bolts securely.

15. Lag pedestals 27 (section W-W) to the entering tie. Fasten the rail to the pedestals with rail clips 30, bolts 28, lock washers 29, and strap nuts 31.

    NOTE: If an insulated joint is located at the entering or leaving end, refer to the special instructions supplied with the installation. If long flange guides are used, also see the special instructions.

16. Bolt "H" beam 55 (section P-P) to the leaving tie using rods 93, nuts 68 and 82, OG washers 81, and

lock washers 29 (see Figure 2). Install plate 92 between the rail and beam 55 on both sides to accommodate the rail size. Using straps 94, connect tie beam 55 to the retarder proper (see NOTE in Step 15).

At this stage, the track can be used (if properly tamped) to transport parts for the assembly of other retarders, or the work can continue as follows:

17. Assemble lower bearing bracket 48 (sections X-X and Y-Y) to angle bar 38 with 5-1/2" bolts 52, 7" bolts 46, and strap nuts 47, which have 4-1/4" centers. Do not securely tighten the bracket bolts until step 24.

18. Lay lower lever 18 (section Z-Z) in approximate position and block the outer end. Insert bushing 36.

19. Move all cranks 17 (section S-S) to their extreme open position (to the right) and place operating bar 16 on the cranks.

20. Clean operating bar pins 15 and use them to connect cranks 17 to operating bar 16. Start at one end and drive the pins in place - use wooden blocks to prevent damage to the pins.

21. Remove the trunnion from main adjusting rod 19 and place it in the proper hole in the lower half of lever 18, making sure that the grease fittings face up and are on the outside.

22. Assemble the upper half of lever 18 over bushing 36 (section Z-Z) and the trunnion on rod 19.

23. Install channel bar 14 (section S-S) leaving out bolts 43 (sections X-X and Y-Y).

24. Install upper bearing bracket 42 on channel bar 14 with 3-3/4" bolts 43 and strap nuts 44, which have 3-1/2" centers.

25. To install bell crank 23 on the bearing brackets, remove the cotter, nut, and washer from stud 49 (section X-X). Insert bushing 50 in crank 23. With nuts 32 and 33, and washer 34 on stud 49, drive in the stud and replace the washer, nut, and cotter on the lower end.

26. Assemble levers 18 to the angle bar by inserting studs 39 and 35 (section Z-Z) in the same manner as in step 25. Be sure that the small "x" stamped on the top of stud 35 is positioned at 90° to the edge of the bar and toward the rail. Insert angle oilers 37 in the tail ends of levers 18.

    NOTE: Tighten the nuts securely to ensure that the parts engage with bushings 36, 40, and 50.

27. Reassemble main adjusting rod 19 on the trunnion which was placed between the ends of levers 18. Connect the rod to triangular crank 23 using pin 20, shim washers 22, and cotter 21.

28. Attach the mechanism to the mechanism ties using through rods 83, nuts 68 and 82, OG washers 81, and lock washers 29 (section S-S). Connect the mechanism to the retarder with bolts 80 which fit tightly in the holes in both the mechanism and angle bar.

    If necessary, shim under the feet of the mechanism to obtain a relatively level plane between the top of the mechanism and both of the rails - in some cases, it may be necessary to adze the ties. Do not "twist" the mechanism by undue tightening on one foot and not on the other.

    NOTE: Do not connect the mechanism throw rod until the mechanism is tested and operated with power, to be described later.

29. Install the shoe beams - end shoe beams 1 and 2 assemble at the entering end of the retarder; intermediate beams 3 are used at all other locations. Spread the levers sufficiently to clear the chair lugs by moving the cranks as far as they will go beyond the normally open position. Drop in the shoe beams. Where retarders are to abut existing retarders, see the special installation instructions for assembly of the shoe beams.

    NOTE: Be sure that strap nuts 31 on top bolts 28 (section S-S) lie in a horizontal plane to prevent interference with the row of shoe beams next to the mechanism when they are in the removal position.

30. Install flange guides 11 and 12, wheel supports 10 and 13, and bearing brackets 54 (section P-P) at the leaving end of the retarder. See the special instructions if long flange guides are used.

31. Install shoe beam centering springs 6 and 7. Locate springs 6 (light weight and painted gray) between the chair ear bosses and the shoe beam bosses on the far side of each rail. Locate springs 7 (heavier and painted black) on the near (mechanism) side of each rail. Heavier springs 7 are easily installed with a special spring installer, as described in PART IV PARTS REPLACEMENT.

32. Assemble shoes 8 and 9 on the shoe beams - shoes 8 on the outside beams; and shoes 9 on the inside beams. Use bolts 67, nut 68, and non-wrinkled lock washer 69 (section S-S). Nuts 68 can be "power wrenched" - be careful not to strip the threads.

33. The shims, hold down plates, and retainers 66 and 58 are to be installed later in step 41.

34. Install the proper hydraulic grease fittings on all

pins, studs, etc. Tighten the fittings on all exposed pins (etc.) until the tip is flush with the top of the pin. Fill the counterbore with grease.

35. Install spring rings 25 (with the special pliers, see Plate MO161) in the slot in the upper portion of the bearing above the top of crank pivot pin 26 (view at U). Assemble cap 24 on the top of the bushing above the pin. Install cotters where required.

36. Lubricate the retarder mechanism as described under PART II LUBRICATION "Retarder Mechanism".

37. Follow the procedures in PART III if it becomes necessary to adjust the mechanism controller contacts.

    The row of contacts nearest the cams are the reverse contacts and those farthest away are forward contacts. Check contact adjustment as follows:

    a. Crank the mechanism and check the dial with the crank pin in the center of the tapped hole on the throw rod end of the mechanism. It should be 12°. Add or subtract any variation from 12° at the crank pin.

    b. Line up the contacts, starting with the roller in space 4 on the dwell of the cam and with forward contact 4 open approximately 1/8". See Figure 5.

    Typical contact adjustments are shown in Table 1. For special contact arrangements, consult with GRS. The forward interlock contact breaks at 147° while the reverse interlock contact breaks at 0°.

Retarder Position	E, E1, E1H, E1HS Dial Reading Reverse Contact Breaks	E, E1, E1H, E1HS Dial Reading Forward Contact Makes	E160 Dial Reading Reverse Contact Breaks	E160 Dial Reading Forward Contact Makes
4		20°		22°
3	65°	76°	70°	86°
2	82°	93°	86°	99°
1	96°	106°	98°	112°
0	*124°		*132°	

* reverse contact in line with forward contact.

Table 1. Typical contact adjustment.

38. Seal the mechanism wire outlet to prevent brake shoe dust from collecting on the terminal board.

39. Connect the mechanism throw rod to the mechanism. Crank the mechanism to 145°. Adjust the eye on the throw rod, which is connected to bell crank 23 with pin 41, Figure 1, section X-X, so that the distance from the center of the pin to the mechanism side of angle bar 38 is 26-3/16" for a Type E, E1H, or E1HS retarder, or 25-9/16" for a Type E160 retarder.

    Lock the nuts on the throw rod against the eye.

40. Apply grease to the pin which connects the throw rod to the mechanism bull gear. Insert the pin and install the locking screw with its washer and lock washer. After a retarder has been in use for several days, check the adjustments in steps 39 and 40 - readjust, if necessary.

41. Using shims 51 (Figure 1, section X-X), shim the eye of the mechanism throw rod in the jaw of bell crank 23 to ensure there is no bind on the pin in the mechanism bull gear.

42. Referring to the instructions in PART III, install enough shims 63 and 64 back of bearing 65 (section T-T) at all inert sections 84 to provide a shoe spacing of 6" as measured at the point where the replaceable shoes start. Install hold down angles and plates only at locations where shims are needed. This prevents unnecessary bolt corrosion and permits easier shim installation. Drill and tap big end bearings 45 and install retainers 58 (view at M) with the 3/4" bolts 69 and lock washers 70 and 71 to hold down the shims at this location.

43. After cars have been handled by the retarder for several days, install shims where necessary to compensate for variations in shoe spacings. Later, shims may be inserted to compensate for wear of the retarder parts. Shoe wear is compensated for by readjusting the nuts on throw rod 19.

44. NOTE: After a retarder has been in heavy service and handled cars for about 2 or 3 weeks, check each cross bar 56 ("T" head) for proper seating in its bearing in crank 17 (section S-S) while cars are going through the retarder closed to the "H" position. If the top portion of the "T" head is not seating, add shims 75, 76, and/or 77 (described later) between the back of big bearing 45 and the ends of channel beams 90 and 91 (Figure 2) on the top of two bolts 28 only (section W-W). If the bottom portion of the "T" head is not seating, add shims at the bottom of the two bolts. Loosen bolts 28 and use a jack to provide the space for easy installation. Tighten the bolts and check with cars going through the retarders closed to the "H" position to ensure final shimming is correct.

45. Make all wiring connections to the mechanism - do not close the breaker on the contactor panel.

46. Position the retarder lever on the control machine panel - lever positions are shown in Table 2. Typical cam arrangements are shown in Table 3.

Retarder Position	Type E, E1, E1H, E1HS Lever Position	Type E160 Lever Position
0	0	0
1	-	L
2	L	-
3	-	H
4	H	XH

Table 2. Control lever positions.

47. Close the main disconnect switch and flash the circuit breaker. If operating properly, close the switch. Check all lever positions from every other position for correct operation.

48. Position the retarder to the H position for the Type E, E1, E1H, or E1HS (or XH position for the Type E160) and adjust the shoe spacing to 3-3/4" (or 3-1/2"). Adjust the nuts on rod 19 to provide the proper shoe spacing.

Retarder Operated		Mechanism Stopping Point	
From Position	To Position	Cam Arrangement Types E, E1 E1H, E1HS	Cam Arrangement Type E160
4	0	134° to 140°	140°
0	1	85°	107°
0	2	70°	92°
0	3	50°	80.5°
0	4	11°	15°

Table 3. Typical cam arrangements. The table may not apply to mechanisms with special cam arrangements. For further information, consult with GRS.

NOTE: After a retarder is placed in service, check the shoe spacing at least once a day until the parts become seated, and then at least once a week thereafter.

PART II

LUBRICATION

GENERAL

To ensure that the car retarder functions properly under all weather conditions, thorough periodic lubrication is an absolute necessity, particularly of all exposed parts.

Lubricate all bearings and sliding surfaces at least once a week, or more frequently under adverse conditions. Excessive lubrication is better than inadequate lubrication.

RETARDER

In Figure 1, external parts to be lubricated with Viscolite Extra-Heavy oil (Socony-Mobil), or equivalent, are shown with black triangular references. Apply the selected lubricant with an oil can.

One of two different methods may be used to lubricate the external sliding parts shown with black circle references. The two methods involve the use of heavy oil applied with an oil can, or cut grease or dry graphite applied with power-operated spray equipment.

The first and most economical uses Viscolite Extra-Heavy oil, or equivalent. If the lubricant requires thinning, heat prior to application. Do not thin with a solvent as the oil washes off easily with rain.

The heavy oil method results in an oily accumulation in the ballast which cannot be corrected unless all ballast is replaced. Also, it may be necessary to resurface the ballast bed frequently to maintain proper level and gradient. In addition, oil collects blowing sand or dirt which acts as an abrasive.

The second, and recommended, method uses Graphite Grease No. 3 (Socony-Mobil) thinned with three parts Chlorothene (Dow Chemical), or an equivalent lubricant prepared according to the manufacturer's recommendations.

Suitable spray equipment can be purchased from any reputable manufacturer. A suggested list is shown following:

SPRAY GRAPHITE LUBRICATING EQUIPMENT

Binks Manufacturing Company
Chicago, Illinois

QUANTITY	STOCK NO.	DESCRIPTION
1	83-5507	Tank, complete with regulator and air motor agitator.
1	7ED	Spray gun, heavy-duty, complete with 52-2360-30-inch nozzle extension.
1	54-977	Air and fluid bottom connection.
1	72-197	Adapter
100 feet	71-107	Air hose (3/8-inch inside diameter), rubber covered, two braid, with 1/4-inch standard pipe couplings (assembly 71-5319).
50 feet	71-107	Air hose (3/8-inch inside diameter), rubber covered, two braid, with 1/4-inch standard pipe couplings (assembly 71-5300).

SPRAY GRAPHITE LUBRICATING EQUIPMENT CONT'D

QUANTITY	STOCK NO.	DESCRIPTION
50 feet	71-208	Fluid hose (3/8-inch inside diameter), rubber covered, two braid, with 3/8-inch standard pipe couplings (assembly 71-6103).

The spray method results in (1) a decrease in application time, (2) virtually no accumulation in the ballast and, (3) less waste in application.

Parts to be greased with a pressure gun are shown with black square references in Figure 1. Use Mobilux No. 1 grease (Socony-Mobil), or equivalent.

To ensure that the cavaties are full, pump in the grease until it begins to discharge from around the pin or rod.

It is recommended that grease be purchased in standard drums and, to prevent contamination, pumped directly from the drum into the hand guns or lubrication machine. Suitable equipment is commercially available to simplify the work.

RETARDER MECHANISM

The lubrication points for the retarder mechanism are shown in Figure 4. Check the gear case oil level and grease the mechanism at least once a week as follows:

Gear Case Oil

Maintain the gear case oil level at 1-1/4 inches below the top of the gauge pipe located at the side of the mechanism. If required, lift the cap on nut 4 and add Socony-Mobil Gear Oil Mobilube EP 80-90, or equivalent. The total capacity of the gear case is 30.4 pounds. Replace the cap after lubrication.

CAUTION: Keep cap 15 and cap 23 tight to prevent leakage.

Greasing and Oiling

With the retarder in the fully closed position, lift the cover on nut 4 and grease pin 3 with Socony-Mobil Mobilux No. 1 grease, or equivalent. Close the cover firmly after lubrication.

NOTE: Nut 4 acts as a holding device to prevent pin 3 from rising. Mechanisms furnished since 1963 include set screws to retain pin 3 in position.

1. Remove inspection plug 2 and grease the engaging surfaces of the bevel gear and pinion. Leave the inspection plug finger tight.
2. In addition to grease, apply oil around upper bearing crank hole 7.
3. Pump grease into bearing 5 until it discharges from the pilot hole in the upper plate. Check by slipping a piece of cardboard under the mechanism controller.
4. Approximately every six months, lightly grease the double-shielded ball bearings on Reliance motors. To grease, remove the slotted plug from the hexagonal grease relief fitting, and insert the pressure fitting in place of the slotted plug. Apply pressure until the grease discharges approximately 1/8 inch from any of the small holes in the flat sides of the hexagonal relief fitting. The grease fitting at the mechanism end of the motor is on the bearing housing proper. The grease fitting at the brake end is brought out at the top of an extension pipe.

   Every five years, remove all old grease and repack the housing cavities adjacent to the bearings 2/3 full with fresh grease.

   NOTE: Hydraulic grease fittings are omitted from the motors to prevent overlubrication.

   Lubricate older General Electric or Westinghouse motors at the overflow pipes on the bearings with Gargoyle Arctic C Oil, or equivalent.

   NOTE: Do not apply oil at the cover openings. The cover openings are used only to inspect for the proper functioning of the oil rings when the motor is running.
5. Lubricate the cam-engaging roller bearings of the mechanism controller, Figure 5, with a very light oil to ensure free rotation.
6. Apply Super Flake Slip-Plate, or equivalent, to all pivot points on the motor brake assembly, Figure 6.

CONTACTOR PANEL

Do not use oil and grease on any part of the contactor panel. To ensure free operation, apply Molykote dry lubricant weekly to the spring shafts of all interlocks.

PART III

PREVENTIVE MAINTENANCE

GENERAL

Satisfactory operation of the car retarder depends upon proper inspection and correct adjustment procedures. Some procedures are performed only once after a retarder is placed in service, or rebuilt. Others are conducted periodically on a daily or weekly basis. Program these procedures on a check-off list to ensure that they are performed at the proper time.

Periodically, inspect the retarder for loose shoes, nuts, bolts, etc. Impact wrenches help to keep parts secure for a long period of time.

Six months after the installation is placed in service and annually thereafter, disassemble a section of one heavily used retarder and examine all pins, bushings, sliding surfaces, etc., for indications of improper lubrication. If this condition exists, corrective measures should be taken.

It is recommended that retarder measurements be taken approximately twice a year and forwarded to the General Railway Signal Company on GRS Retarder Measurement Forms SK-3057-91A. The use of this service enables the user (1) to keep each retarder properly shimmed and adjusted, (2) to establish rates of wear for each retarder, (3) to properly plan for major rebuilding and repairs without seriously disrupting normal yard operation, and (4) to distribute the cost of major repairs over an extended period of time.

Drainage

Keep the layout in good condition and well drained to protect against possible water accumulation between the steel cross members and adjacent ties. This will prevent the formation of ice on the spring assemblies in the winter.

Winter Service

In the fall, inspect the mechanism gear housing for possible water accumulation - drain if required. Remove the caps under the housing to drain the lower bearings.

During a heavy snow or sleet storm, operate the retarder frequently. Leave the retarder in the closed or H position when not in use to prevent snow and ice from packing between the shoes.

If kerosene snow melters or weed burners are used to melt ice and snow, check that they are not directed at one place long enough to remove the temper from the springs or burn off the lubricant. Do not use fuels which are poured on the ice and snow and then ignited.

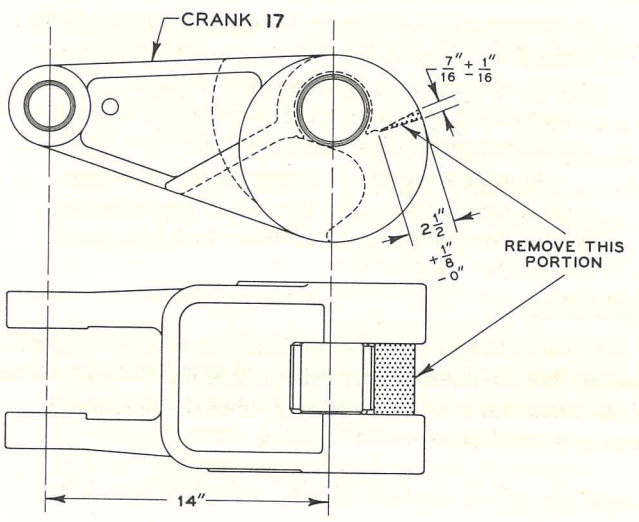
RETARDER

Shoe Position (Figure 1)

1. Operate the retarder from the "O" to the "H" ("XH" for Type E160) position - full stroke, not step by step.

2. Adjust the shoes, by means of nuts 33 (section Z-Z), for a 3-3/4 inch spread (3-1/2 inch spread for Type E160). Measure near the center of the shoe beams opposite each mechanism to obtain an average of approximately 3-3/4 inch shoe spacing for operated sections of the entire retarder (3-3/4 inch is average for the two rails). As a result of wear, the shoe spacing for the entering end of the retarder may be somewhat "open" and for the leaving end somewhat "tight". However, the shoe spacing for the entire retarder should average approximately 3-3/4 inches.

CAUTION: On car retarders shipped prior to 1956, approximately the last 5-inches of thread on main adjusting rod 19 is not usable as the solid portion of cranks 17 (between the upper and lower T-head cross bar seats) interferes with the side of the cross bar when the rod reaches the 5-inch dimension. Before this condition occurs, install plate shims 63 and 64 between all fixed lever bearings 65, large bearing 45, and bridge bracket 62 at all operated sections. When rebuilding the retarders, cranks 17 may be machined, as shown following to permit full use of the adjusting rod.

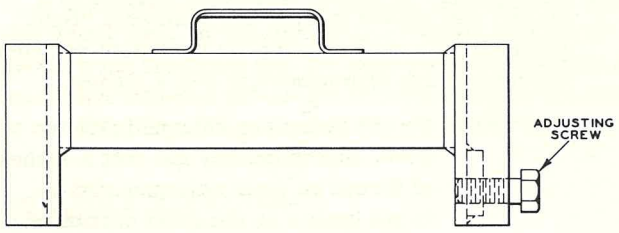


Field machining of cranks 17.

3. On a new retarder, install shims 63 and 64, as required, to align the shoe beams and provide uniform shoe spacing. Shims of 1/8, 1/4, 1/2, and 3/4-inch thickness are available. Install shims of proper thickness combinations at all operated sections to compensate for cumulative wear of the retarder parts.

   A shim installer, shown below, is available to facilitate the installation of shims. With the retarder closed, place the installer over the rail so as to span the two retarder shoes. Tighten the adjusting screw by hand. Place the retarder in the "open" position and relieve the pressure of the shims. Remove or insert shims as required.

   NOTE: Angular, cast-steel shim holders are available in place of existing shim holders. They are installed on large bearings 45 with a 3/4-inch tap bolt.



Shoe beam shim installer.

4. At all inert sections, insert sufficient shims behind lever bearings 65 to provide a 6-inch shoe spacing at the end of the removable shoes. Inert sections are used at entering and leaving ends of all retarder units and also at the articulations where retarders abut (except on Type E1 retarders which abut on operating sections).

   IMPORTANT: Maintain the 6-inch shoe spacing at all inert sections.

5. When a retarder is first placed in service, high areas on the faces of the bearings seat rapidly. Check the shoe spacing at least once a day until a minimum of 25,000 cars have passed through the retarder, or until the 3-3/4 inch (3-1/2 inch for E160) spacing is established and remains constant. Thereafter, check the retarder for the correct shoe spacing at least once a week.

   Do not use shims to compensate for faster initial wear at the entering end of the retarder. Adjust for proper wear as described previously.

Cross Bars

After a retarder has been in heavy service for approximately two or three weeks, check that the T-head portion of all cross bars 56 seat properly in their bearings in cranks 17 as follows:

1. Observe when cars pass through the retarder in the closed, or "H" position. If the top portion of the "T" head is not seating properly, add shims 75, 76, and 77 (1/32, 1/16, or 1/8-inch thick) between the back of large bearing 45 and the ends of the channel beams on the top two bolts 28 only. If the bottom portion of the "T" head is not seating properly, add shims to the bottom two bolts also.

2. Loosen all four bolts and use a jack to facilitate installation.

3. Tighten the bolts and observe cars passing through the retarder in the closed, or "H" position, to ensure that final shimming is correct.

4. Check the seating of the bearing every 6 months, and correct if necessary. Frequent shimming is an indication of excessive wear resulting from improper lubrication.

Throw Rod

Adjust the eye on the mechanism throw rod to obtain a measurement of 26-3/16 inches (25-9/16 inches for Type E160) from the mechanism side of angle bar 38 to the center of pin 41 (X-X). To obtain this measurement, crank the mechanism so that the gear box dial reads 145 degrees. Lock the nuts against the eye after adjustment.

Check this measurement after the retarder is operated for two or three weeks, or whenever a retarder is reassembled.

RETARDER MECHANISM

Periodically, check the current drawn by each retarder mechanism. Normally, current is 12 to 18 amperes at the time the motor cuts off when operating the retarder with no car present. Excessive current is an indication of undue friction in the retarder or retarder mechanism. This condition should be remedied.

Controller (Figure 5)

CAUTION: Before servicing or cranking the retarder mechanism, disconnect the isolation switch or circuit breaker on the contactor panel.

Generally, the mechanism controller does not require adjustment other than the replacement of a burned or deformed contact.

To replace a contact, proceed as follows:

1. Note the original adjustment and install the new contact.

2. Crank the mechanism to place the No. 4 roller on the dwell of the cam, and adjust the No. 4 forward and reverse contacts for an approximate 1/8-inch contact opening.

3. Align all other contacts with the No. 4 contacts.

4. Adjust all movable contacts for approximately a 1/16-inch contact wipe, that is, a contact moves 1/16-inch after the center finger closes with either of the outside fingers.

5. When adjustment is complete, place the retarder control lever in the "L", or No. 2 position.

6. Observe the dial on the main-gear shaft, and operate the switch or circuit breaker on the contactor panel momentarily to ensure that the retarder operates in correspondence with the position of the control lever. Close the switch permanently after adjustment is complete.

   CAUTION: Do not operate a retarder by punching the contactors by hand.

7. Approximately every two months, lightly brighten the contacts with fine sandpaper.

8. If a contact finger or the terminal board is disassembled, adjust all contacts as described previously.

Motor

Check that the motor brushes move freely and make even contact on the commutator. Replace the brush holder springs if spring tension and brush pressure is insufficient. Brush pressure should be 12 ounces. On motor 52595-15, a self-adjusting spring controls the brush pressure.

To check brush pressure, proceed as follows:

1. Connect a spring scale to the brush-holder finger. Hold the scale in alignment with the brush.

2. Insert a strip of paper between the face of the brush and the commutator.

3. While pulling on the scale and strip of paper, read the tension required to release the paper.

4. New brushes must be of the same grade as those originally used. Fit and seat each new brush carefully to the commutator. Use No. 00 flint or garnet paper. Never use emery cloth on the commutator or brushes. Check that the bottom of each brush holder is approximately 1/8-inch from the surface of the commutator. Check also that the brush holder body is in alignment with, and properly spaced around, the commutator.

5. Periodically, wipe the commutator with a piece of canvas or fine grade of rubber-bond type commutator stone. If the commutator becomes rough, polish with a sandpaper block cut to fit the curvature of the commutator. Do not use emery cloth or a lubricant. Motors in heavy service may require burnishing with a fine rubber-bonded commutator stone, and cleaning between the bars to increase in-service life. Do not turn or undercut a commutator unless absolutely necessary. A new commutator has a nominal diameter of 5-1/2 inches and may be turned to a minimum of 5 inches. On motor 52595-15, do not turn the commutator to less than 5-1/8 inches.

6. If a motor becomes wet, pass current through the fields and armature separately to heat the windings. Do not overheat the windings so that the bare hand cannot be held on the motor continuously.

Motor Brake (Figure 6)

Check the operation of the motor brake regularly – several times a day for the first few days when new, or when new brake shoes are installed – until the lining and brake wheel are properly seated. Thereafter, check at least once a week. Tighten the brake sufficiently to hold while cars pass through the retarder and still not drag when the retarder is operated without a car.

To operate properly, the armature air gap should be approximately 0.066 inch with release lever 8 in the down position, and approximately 0.016 inch in the up position. Check that the air gap at the center of the coil case measures approximately the same on both the right- and left-hand sides. To change the air gap, proceed as follows:

1. Remove the cotter pin from screw 6.

2. Remove screw 6.

3. Turn armature stud 7 in or out as required.

Back off studs 1 so as not to engage the brake levers. Studs 1 in brakes now being supplied are cut off.

To adjust the brake, proceed as follows:

1. Compress spring 3 to approximately 2-1/8 inches.

2. Lift release lever 8, and firmly grasp brake rod 4.

3. Adjust front and back nuts 5 so there is only a small amount of shake in the shoe assembly.

4. Check the adjustment by manually rotating the brake wheel. Be sure that the brake wheel is hot before testing.

5. Lower release lever 8.

6. Operate the empty retarder and adjust spring 3 as tight as possible to provide fast brake operation without drag or overrun. The spring should be approximately 2-1/16 inches with sintered linings, approximately 2-1/8 to 2-3/16 inches with woven linings. Do not include the spring seat

or washer in this measurement. Brakes now being supplied are equipped with an oval wire spring. Adjust in the same manner as previously described, except compress the spring to approximately 2-5/8 inches, rather than 2-1/16 inches.

NOTE: With the shunt-type brake, adjust the brake resistor to a value of 20 ohms before performing the preceding procedure.

7. Check all brake parts and lubricate all pivot points lightly.

CONTACTOR PANEL

Contactors (Figure 7)

Keep the contactor panels free of dirt, oil, and grease. Inspect the contacts once a week. If prominent beads form on the contact surface, dress down with a fine file. Do not use sandpaper or emery cloth.

New contacts should meet in advance of the final seating of the armature against either the upper or the lower pole face. A gap of approximately 1/8-inch should appear between the underside of the contact and the outside edge of the fully-seated armature. When the contact wipe decreases to 1/32-inch, replace the contacts.

As the car retarder motor draws considerable current, it is unnecessary to polish the contacts. The main problem is metal transfer and buildup on the contact tips. When metal buildup occurs on contact tips, dress down the contacts with a fine file to remove irregularities. This action prevents excessive burning and, thus, lengthens the life of the contacts.

The contactor armature and bearings do not require adjustment or lubrication other than periodic removal of accumulated dirt, etc. Do not clean with oil.

Timetactor (TR)

The timetactor and associated equipment are used with panels 52804-7 and 52804-8 only.

To obtain the full time delay period, check that the plated ground surface of the frame, core, and armature are perfectly clean. When parts are clean, the armature is held closely by residual magnetism if energy is removed from both windings.

Do not apply grease or oil to the knife-edge bearings or to the ground surfaces. Clean periodically.

Replace worn or severely burned contacts. Moderately burned and blackened contacts usually do not require replacement or dressing, as the discolored surface is generally a good conductor.

Periodically check the timetactor for 4- to 5-second operation by opening the F or R interlock. If necessary readjust in accordance with the test procedure described later in this publication.

PART IV

PARTS REPLACEMENT

GENERAL

Certain parts of the retarder, such as retarder shoes, brake shoes, motor brushes, and contactor tips, must be replaced as they wear out during normal operation. Various kinds of failures or derailments may also necessitate the replacement of parts. The adjustments presented in this section do not supersede the adjustments described in the preceding section. Replace worn or damaged parts with identical parts. Satisfactory performance is not guaranteed if substitute parts are used.

RETARDER

Shoes (Figure 1)

Replace shoes when worn to an approximate one-inch thickness. Two kinds of shoes are used: those for outside beams with 1-1/2 inch faces, and those for inside beams with 1-inch faces. In most cases, it is necessary to replace inside and outside shoes at different times to obtain full shoe wear.

NOTE: Use shoes with 1-inch faces only on inside shoe beams.

To replace worn shoes, remove bolts 67 (section S-S). A power wrench may be used. Avoid stripping the threads. When replacing a single shoe, check that the face of the new shoe is in approximate alignment with the faces of the old shoes. After a time, a new shoe wears to a point that it matches adjacent shoes. It is recommended that, initially, one retarder be furnished with new shoes when the existing shoes are approximately half worn. Thus, a stock of worn shoes is available for replacement.

After a set of shoes is replaced, adjust for proper shoe spacing as described in PART III under "Shoe Position".

Two type shoes are available for use with Types E and E1 retarders: (1) outside shoes (one-half inch higher than standard shoes) which provide approximately 5 percent additional retardation with the same shoe life, and (2) special alloy inside shoes which provide about 15 percent additional retardation with a maximum life of 70 percent of standard shoes.

A retarder with high outside and standard inside shoes is designated Type E1H or E160. A retarder with high outside and special alloy inside shoes is designated Type E1HS.

Shoe Beams

To remove a shoe beam, proceed as follows:

1. Place the retarder in the open position and pull pin 41 (section X-X) from the mechanism throw rod.

2. With a lever Coffing hoist, move cranks 17 as far as possible beyond the normally open position. To prevent interference, check that strap nuts 31 on top bolts 28 (section W-W) lie in a horizontal plane.

3. Remove coil springs 6 and 7 and, if necessary, shims 63 and 64. Lightweight coils springs 7 factory-painted gray) are used on the far side of each rail between the chair ear bosses and shoe beam bosses. Heavy-weight springs 6 (factory-painted black) are used on the mechanism side of each rail. For retarders having a large number of fixed lever bearing shims, the beams may be quickly removed if a crane is available to pull out fixed lever bearings 65 to free the shims.

4. Replace the shoe beams and insert the coil springs. A shoe beam spring installer, shown following, facilitates installation. Proceed as follows:

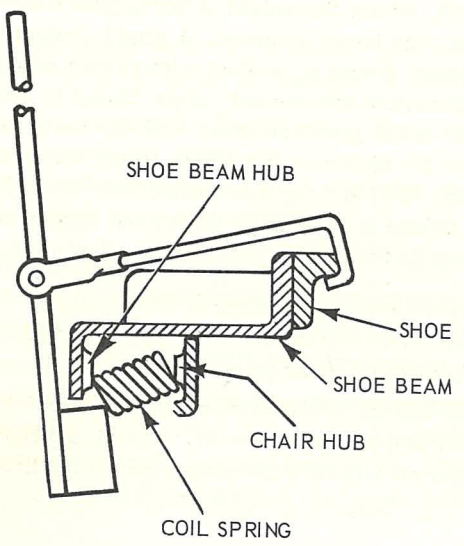
   a. Hook the installer over the shoe beam and onto the shoe.

   b. Position the spring in place on the chair hub.

   c. Compress the spring to clear the shoe-beam hub.

   d. Tap the spring into place.

If leaf springs are used, pry up on each end of the shoe beam to slide the springs past the edges of the chair lugs. The shoe beam will then be free. To replace the shoe beam, slightly compress the ends of the leaf spring and slide in place on the chair lugs.



Shoe beam spring installer

Spring Rods

To replace short spring rod assembly 84 (inert sections) and long spring rod assembly 73 (intermediate sections) proceed as follows:

1. Remove shoe beams 3, 1, and 2 and back off the spring rod lock nuts with the special ratchet socket wrench.

2. Back off the spring rod flange nuts. Slip the spring seat from one lever and then from the other. Remove the spring rod assembly.

3. To reassemble, place the spring seats on the levers.

4. Tighten the flange nut to take up all play in the assembly. Back off at least three full turns to ensure that there is no initial compression on the spring.

   IMPORTANT: Spring rods which are too tight may break. If breakage occurs because of tight adjustment, back off the flange nut five turns.

5. Tighten the lock nut while holding the flange nut.

   NOTE: On car retarders designed for handling empty cars only, special, factory-painted gray, light-pressure springs are used at intermediate sections; regular, long, factory-painted black springs at inert sections.

Spring Levers

Lift out spring levers 74 (section S-S) after removing the shoe beams and slipping the spring rod seats from the levers.

Cross Bars

Cross bars 56 are assembled with a cast bracket on the far rail end to provide a spring-loaded stop for lever 74 at that location. Assemble spring 87, stop 88, bolt 89, and the collar nut as shown in Figure 1, view at N. Tighten the nut so that the cotter pin enters the hole in the bolt.

To remove cross bar 56, proceed as follows:

1. Remove the shoe beams, spring rods, and floating levers 74 (far side of rail). See Section S-S. Do not remove fixed levers 74 (near side of rail).

2. Remove pin 15, swing aside crank 17, and remove cross bar 56.

   NOTE: Replace older type cross bars with cross bars which have a spring-loaded stop.

Chairs

Chairs 4 are mounted outside the rail; chairs 5

inside the rail. The inside chairs have elongated holes in the base flange. Properly positioned, the chairs space the rail at approximately 56-11/16 inches gauge. To remove a chair, first remove the shoe beams. Block or wire the spring levers in place to prevent the spring rod assembly from disengaging. Remove the track bolts, beam bolts, and chair. To replace, assemble the track bolt nuts on the inside of the rail.

RETARDER MECHANISM

When ordering replacement parts for the retarder mechanism, list the drawing number stamped on the name plate.

Gear Box Dial (Figure 8)

Dial 1, graduated from 0 to 150 degrees, is attached to the gear box around the end of the main-gear shaft. A scribe line indicates the position of the crank pin to which the mechanism throw rod is attached.

The cams and contacts in the mechanism controller (described following under "Controller Assembly") are arranged to operate as shown in Table 3. As individual mechanisms have different operating characteristics, readings may vary slightly.

NOTE: On mechanisms now being furnished, emergency contacts open at approximately 0 to 147 degrees.

Retarder Operated		Mechanism Stopping Point	
From Position	To Position	Cam Arrangement Types E, E1 E1H, E1HS	Cam Arrangement Type E160
4	0	134° to 140°	140°
0	1	85°	107°
0	2	70°	92°
0	3	50°	80.5°
0	4	11°	15°

Table 3. Typical cam arrangements. The table may not apply to mechanisms with special cam arrangements. For further information, consult with GRS.

If it is necessary to remove gear 3, mark its mesh with gear 2 to ensure the same relationship after reassembly.

Controller Assembly (Figure 5)

The mechanism controller consists of a set of cams and their respective contacts. When the control lever is operated, the motor-control circuit is energized to move the retarder to the desired position. The cam-operated contacts are adjusted to open the motor-control circuit when the called for position is reached.

A retarder which repositions, that is, moves beyond the called for position and then comes back, is said to be overrunning.

If it is necessary to remove the controller from the mechanism, replace as follows:

1. Insert the crank and rotate the gearing until the scribe line on the end of the shaft is in alignment with the 12-degree mark on the gear box dial. See Figure 8.
2. Place the controller on the mechanism with gear W in mesh so that scribe line X across the cam collars is in alignment with scribe line Y on the bearing boss.
3. Check the gears for backlash; a small amount is necessary to prevent binding.

NOTE: Whenever the cams are reassembled on the shaft of the controller, align the scribe lines across the face of the cams to ensure correct positioning of the retarder.

Bevel Gear and Pinion (Figure 4)

Mechanisms now being supplied have 20-degree gears and are so marked; mechanisms already in service have 14-1/2 degree gears and are unmarked. When replacing gears, check that both the bevel gear and bevel pinion are the same degree. It is recommended that worn or broken 14-1/2 degree gears be replaced with a pair of 20-degree gears. During replacement, adjust the height of the bevel gear, and mesh with the bevel pinion as follows:

1. Remove pipe plug 2 to observe bevel gear 6 and bevel pinion 9 during the adjustment procedure.
2. Remove cap 23 and lock nut 8. Back off adjusting nut 7.
3. Screw the pinion assembly in or out to align the bevel pinion teeth with the bevel gear teeth. With nut 18, adjust the height of bevel gear 6 for proper mesh with bevel pinion 9. A slight amount of backlash should be evident with proper adjustment. To facilitate adjustment, apply bluing to the teeth of the bevel gear and mesh with the bevel pinion. When the bluing on the pinion shows the proper mesh, drill and tap a setscrew hole in adjusting nut 18 and in the case. Insert and tighten setscrew 21 to hold the bevel gear adjustment.
4. Replace cap 23 and seat adjusting nut 7 at the top of the bevel gear shaft. Back off nut 7 one notch and secure with lock plate 8.
5. Drill and tap a setscrew hole in the mechanism cover and pinion sleeve 11. Insert and tighten setscrew 1 to hold the pinion gear adjustment.

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Motor

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6. As a final check, crank the mechanism several times through a full gear mesh in both directions. The mechanism should operate freely without undue noise and slap.

7. Replace pipe plug 2 - leave finger tight to facilitate removal. Tighten caps 15 and 23 to prevent oil leakage. Check that gaskets 14 and 22 are in position under their respective caps.

8. If bearings and other parts are replaced, check that the oil leads are in alignment with the leads in the hubs, etc., to ensure that grease feeds properly.

9. Check that washer 17 and pin 19 are in proper position under pinion 20. Check also that washers 13 are in proper position under main gear 12 and intermediate gear 16.

Motor

1. Before installing a motor, check the motor and mechanism shafts to ensure that the nuts on the coupling hubs are secure. If the coupling hub is removed from the pinion shaft for any reason, replace with the proper shimming so that the bearings rotate freely without noticeable shake.

2. So that grease does not leak from the coupling, seal the space over the hub keys with Minnesota Mining and Manufacturing's 3M Sealer EC-612, or equivalent. Grease the surface of the hubs to protect the neoprene gaskets.

3. Coat the internal and external teeth at both ends of the coupling with Socony-Mobil Sovarex L-O Grease, or equivalent.

4. Check the alignment of the motor-shim as required.

5. Clean the flanges thoroughly and install the gasket. Insert the required bolts and nuts, and draw the sleeves snugly together. Check that the seals seat properly.

6. Bolt the motor securely in place. Check that the motor is pulled as far as possible to the right.

7. Tighten the coupling flange nuts. The coupling compensates for slight misalignment between the motor and gear train. Older couplings may be replaced with gear-type couplings.

8. The coupling is factory lubricated. Check that the two lubricating plugs and associated copper washers are secure.

9. After replacing the motor, and before operation, check that (1) the connections agree with the wiring diagrams, Figure 9 or Figure 10, (2) the brushes move freely in the holders and that the brush pigtails do not foul operation of the brush follow-up spring, (3) the brushes make proper contact on the commutator and the brush springs have sufficient tension, and (4) all motor components are in a safe operating condition. Lubricate the bearings per instructions described in PART II. Check that the drain plugs in the bearing housings are secure. Release the brake and check that the armature rotates freely by hand.

10. Keep the exterior of the motor wiped off. Clean the interior with a cloth and a small bellows or suction pump. Clean the coils with a cloth dampened with carbon tetrachloride, or equivalent cleaning agent.

    NOTE: Before operating the retarder, check that the brake is not released, but is tightened sufficiently to prevent overrun. Refer to instructions described in PART III under "Motor Brake".

11. Replace worn motor bearings. Motor bearing wear is minimized by proper motor alignment in the mechanism case, and by proper lubrication. Clean the bearings and housings before reassembly and lubricate.

12. Provide name plate information when replacing motor parts as two types of Reliance motors are in use, and parts are not interchangeable. However, motors are interchangeable.

Motor Brake (Figure 6)

It is recommended that worn brake shoes be returned to GRS for relining. Mechanisms now being furnished are equipped with sintered linings having a somewhat lower coefficient of friction but excellent "non-fade" characteristics. Do not use sintered linings without first checking as to their use with existing brakes.

NOTE: The dust from sintered brake linings is conductive. Periodically, clean the mechanism terminal board and seal the wire outlet to the cam controller.

To replace a brake coil, proceed as follows:

1. Disconnect the leads and remove brake coil housing 2 from the brake frame.

2. Remove the old coil from the housing.

3. Clean the housing thoroughly to ensure that the new coil will fit properly in place.

4. Wax the inside of the coil and the housing hub. Place the coil squarely in the housing as far as possible by hand. It should be possible to insert the coil at least 1/3 of the way. To seat the coil fully into the housing, hammer on a wooden block placed on the coil face, or draw with a mandrel press.

5. Fill the excess space between the top of the coil and the top of the housing with four pads of 3/4-inch x 0.020-inch Fiberglas tape. Place the large brass washer along with the pole face plate on top of the coil. The pole face plate must not project beyond the rim of the coil housing.

6. If the coil does not draw tightly into the housing, band in four places about the circumference with 3/4-inch x 0.020-inch Fiberglass tape of sufficient thickness to ensure a tight fit.

Brake coils now being supplied are encapsulated in the housing. Encapsulated coils are available for replacement if housings are returned to GRS.

CONTACTOR PANEL

Contactors (Figure 7)

Ordering information for contactor contacts is shown in Table 4.

Contact	GRS Drawing No.	
	Moving	Stationary
Front	17903	17903-6
Back (Stamped D-54)	17903-13	17903-12

Table 4. F, R, and L contactor contacts.

A moving contact is removed by disconnecting its shunt strap and removing the contact spring. A stationary contact is slotted to facilitate removal. To remove, loosen the screw until the dowel, which projects from the back of the contact, is free of the locating hole in the stationary contact support.

When the contacts are new, the gap opening of a normally open contact, measured with the armature seated against the lower pole face, is from 11/32 to 13/32 inch. The gap opening of a normally closed contact, measured when the armature is seated against the upper pole face, is from 5/16 to 3/8 inch.

1. Arc box:

To remove, pull the arc box directly outward allowing the blowout pole pieces (which act as its fixed supports) to guide the sliding movement.

To replace, check that the guiding recess on each side of the arc box is properly located on, and gripped firmly by, the support guides. If the guides are spread apart as to prevent a firm grip on the arc box, remove the box and squeeze the guides together slightly with the fingers. To obtain a tight fit, it may be necessary to bend inward slightly the clips holding the chute. Check that the flexible connection leading from the arc chute is fastened securely to the frame to prevent interference with armature movement.

Panels now being supplied are equipped with 25-ampere contactor blowouts (red). On older panels, the R contactor has 25-ampere blowouts (red) on the front contacts. Back contacts have 50-ampere blowouts (black). The F contactor has 50-ampere blowouts (black) on the front and back contacts. The L contactor has 50-ampere blowouts (black) on front contacts. When replacing contactor blowouts, replace the parts in the same order as they are removed, and replace the mica insulating washers to a 1/8-inch thickness.

2. Armature:

The upper magnet pole face is secured to the core by a bolt head which projects forward into a hole in the armature. Maintain these parts in proper alignment, that is, the bolt head is centered accurately in the armature hole.

3. Operating coil:

When installing a new operating coil, check on the identification label that the voltage rating and coil number are correct for the application. Coils are connected in parallel for 265-volt control; in series for 132.5-volt control. To replace an operating coil, proceed as follows:

a. Remove the arc box(es), as described previously.

b. Loosen the two bolts, which secure the armature stop to the underside of the contactor frame, until the armature stop is lowered clear of the two locating dowel pins.

c. Allow the self-contained assembly to hang by the shunt strap. The assembly consists of the armature, armature stop, and moving contacts and springs.

d. Remove the bolt which holds the pole face to the magnet core.

e. Disconnect the coil leads and slide the coil forward to clear the contactor frame.

Overload Relay (OL)

Two types of overload relays are now in use. The older type has a porcelin base and may be set for automatic or manual reset. For automatic reset, position the setting lever so that the arrow is exactly vertical to ensure good contact pressure.

The newer type overload relay has a composition base and may be set for automatic or manual reset, or for manual reset without manual means of opening the contacts. For automatic reset, properly position the control spring in the push rod notch located on the side of the relay opposite from the heater.

CHANGE NOTICE

From

GENERAL RAILWAY SIGNAL COMPANY
A UNIT OF GENERAL SIGNAL CORPORATION
ROCHESTER NEW YORK 14602

GRS TYPE E
Car Retarders
Pamphlet 1309

REVISE PAMPHLET 1309 AS FOLLOWS:

Page 16 - Under "3. Operating coil", revise the second sentence to read: "Coils are connected in series for 265-volt control; in parallel for 132.5-volt control".

A802-99 A2162 May 1969

At ambient temperature, an overload relay opens in approximately 60 seconds at 150 amperes, or 90 seconds at 100 amperes. It closes in approximately 5 to 7 minutes.

Test Procedure (Figures 11 and 12)

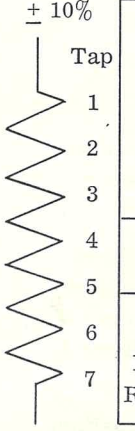
If shop changes are made to contactor panels 52804-7 and 52804-8, test as follows:

1. Apply 265-volt d-c across terminals L1 and L2, with positive on L1.
2. Push and hold the left-hand interlock on forward contactor F or the right-hand interlock on reverse contactor R to adjust relay TR to release in 4 to 5 seconds. Move the slider on the resistor to obtain this adjustment.
3. Apply positive control energy to terminal F (105-volts positive when connected for 3-wire, 132.5-volt control).
   a. With energy applied, forward contactor F and line contactor L should pick up, if the overload and TR contacts are closed. The TR contactor should open in 4 to 5 seconds to release the line contactor only. If contactor F releases, decrease the 1300-ohm resistor to the next lower value, as shown in Table 5. Repeat the preceding procedure after adjustment.
   b. Push the reset button to trip the overload relay. Release the reset button; contactors F and L should release and pick up.
4. Repeat step 3, applying positive control energy to terminal R. Contactor R should pick up and remain up when the TR contact opens. If it does not remain up, decrease the series resistance to the next lower value, as shown in Table 5. Repeat the preceding procedure after adjustment. When tripping the overload relay, contactors R and L should not release.
5. Apply positive control energy to terminal F or R (140-volts positive when connected for 3-wire, 132.5-volt control).
   a. Block open the TR contact. Contactor F should not pick up with energy applied to terminal F. Contactor R should not pick up with energy applied to terminal R. If either contactor picks up, increase the 1300-ohm resistance to the next larger value until the contactors remain down. If the resistance is increased, repeat steps 3 and 4.
   b. Push and hold the right-hand interlock on contactor F. Contactor R should not pick up with energy applied to terminal R.
   c. Push and hold the left-hand interlock on contactor R. Contactor F should not pick up with energy applied to terminal F.

Test Procedure (Figure 13):

If shop changes are made to contactor panel 52804-9 Gr. 1, test as follows:

1. Apply positive control energy to terminal F or R (105-volts positive when connected for 3-wire, 132.5-volt control).
   a. With energy applied to terminal F, forward contactor F and line contactor L should pick up.
   b. With energy applied to terminal R, contactor R and contactor L should pick up.
   c. With positive control energy applied to terminal F, push and hold the reset button to trip the forward overload relay. Both contactors F and L should release. When the reset button is released, they should again pick up.
   d. With positive control energy applied to terminal R, push and hold the ROL reset button to trip the reverse overload relay. Both contactors R and L should release. Release the button - both contactors should again pick up.



Adjustment	Jumper From	Jumper To	Tap on No.	Resistance ± 10%
To Increase Resistance	4	7	5	792 ohms
	4	6	5	756 ohms
	4	6	5	710 ohms
	5	7	5	710 ohms
Normal	---		4	648 ohms
To Decrease Resistance	3	7	4	594 ohms
	3	6	4	576 ohms
	3	5	4	540 ohms

Table 5. Resistor adjustment of contactors F and R.

2. Apply positive control energy to terminal F or R (105-volts positive when connected for 3-wire 132.5-volt control).
   a. Push and hold the right-hand interlock on contactor F.
   b. Apply positive control energy to terminal R. Contactor R should not pick up.
   c. Push and hold the left-hand interlock on contactor R.
   d. Apply positive control energy to terminal F. Contactor F should not pick up.

Circuit Breaker Adjustment

Contactor panels 52804-7, 52804-8, and 52804-9 Gr. 2 are now being supplied with a circuit breaker in

lieu of a knife switch and 100-ampere fuse.

The circuit breaker is a two-pole device operated by a magnetic trip. Operating range is between 160 and 560 amperes. When installing on an existing contactor panel, set the indicator arrow for each pole at position 4. If the circuit breaker opens frequently under normal service conditions, decrease the setting in small increments to prevent erratic operation.

The circuit breaker is operated manually by moving the handle from the ON to the OFF position. If the circuit opens because of an overload, the handle moves automatically midway between the two positions and must be reset manually.

PART V

LOCATING TROUBLE

GENERAL

A systematic and thorough maintenance program is the best way to prevent malfunctioning of a retarder. However, should a malfunction occur, a complete knowledge of retarder operation is essential to locating and remedying the trouble quickly.

RETARDER

As the major parts of the car retarder are exposed, a breakage usually results from the overstress of a worn or fatigued part, or a derailment. To replace and adjust the damaged part, refer to the description in PART IV.

RETARDER MECHANISM

1. If the mechanism repositions (overruns), that is, moves beyond the called for position and then comes back, check for a loose brake.

2. If the main drive gear, which operates the throw rod, overruns the limit of its mesh with the intermediate gear and disengages, remesh the two gears by barring at triangular crank 23, Figure 1, while cranking the mechanism.

   a. If the main gear overruns in the closed position with a car(s) passing through the retarder, re-engage the gears by disconnecting the throw rod from crank 23, and pulling out the rod while cranking the mechanism.

Mechanism controllers are now supplied with emergency contacts to open the control circuit when the main drive gear overruns the 147- or 0-degree position. Also, emergency contacts have been added to a number of controllers already in service. If an overrun occurs with these units, crank the mechanism to close the contacts before attempting to reestablish control.

CONTACTOR PANEL

If runouts occur in the reverse direction, check the brake circuit, particularly the rectifiers. Disconnect the rectifiers from the circuit. A low resistance should be measured in the forward direction and a high resistance (over 100 times) in the reverse direction.

With the shunt-type brake, Figure 12, rectifiers KB and NC are used for reverse dynamic snubbing; JA and MC for forward dynamic snubbing and, QD and PC maintain positive flux in the series field to limit the opening speed of the retarder.

The center-tapped 1.95-ohm resistor regulates the amount of dynamic snubbing obtained in the forward or reverse direction. It is normally adjusted for 0.95 ohm each side of the center tap. The brake resistor is adjusted to 20 ohms for 265-volt control but can be adjusted to maintain between 7 and 8 amperes with a variation of the voltage.

PART VI

HEAVY CAR CONVERSION

GENERAL

The following are general instructions for increasing the capacity of existing Type E retarders. They are to be used as a guide, with reference to the special instructions furnished with the conversion materials.

The materials needed for conversion depend upon the age of the retarder to be upgraded. Replacement parts include longer levers and different mechanism controller cams. It may be necessary to recondition some existing retarder parts due to wear. For this purpose, refer to GRS Specification 12L-144.

RETARDER

1. Remove existing levers 74, Figure 1, section S-S, as follows:

   a. Place the retarder in the open position and pull pin 41 (section Z-Z) from the mechanism throw rod.

   b. With a lever Coffing hoist, move cranks 17 as far as possible beyond the normally open position. Check that strap nuts 31 on top bolts 28 are in a horizontal plane to prevent interference

1375-1-0062

with the shoe beams.

c. Remove coil springs 6 and 7 and, if necessary, shims 63 and 64 (view at M). Lightweight coil springs 6 (gray) are used on the far side of each rail between the chair ear bosses and shoe beam bosses. Heavyweight springs 7 (black) are used on the mechanism side of each rail. For retarders having a large number of fixed lever bearing shims, the beams may be quickly removed by a crane to pull out fixed lever bearings 54 (section P-P) to free the shims.

d. Remove shoe beams 1, 2, and 3 and back off the spring rod lock nuts with the special ratchet socket wrench (see GRS Car Retarder Catalog, Plate MO161).

e. Back off the spring rod flange nuts. Slip the spring seat from one lever and then from the other. Remove the spring rod assembly.

2. Remove about 1-1/2" from the inside edge of the high-carbon alloy steel chairs, Figure 14, mounted on the MECHANISM SIDE of each rail. Cut the chairs (while still in the retarder) as follows:

   a. Preheat to 550° using an acetelyne torch and measuring the heat with "tempil sticks". At the proper temperature, remove the excess material.

   b. Slowly cool the chairs by covering them with powdered asbestos which is available in bags or blankets.

3. Install new long levers 53435-13 as follows:

   a. Place the spring seats on the levers.

   b. Tighten the flange nut to take up all play in the assembly. Back off at least three full turns to ensure that there is no initial compression on the spring.

   c. Tighten the lock nut while holding the flange nut.

4. With the shoe beams removed, check the shoes for clearance. Place total gauge 52778-5 on the beam as shown in Figure 15. If the bevel is not correct, grind the beam to provide the necessary clearance for the new levers.

5. Replace the shoe beams and the coil springs.

6. Replace pin 41 in the mechanism throw rod.

7. Crank the mechanism to 145°. Adjust the eye on the throw rod, which is connected to bell crank 23 with pin 41, Figure 1, section X-X, so that the distance from the center of the pin to the mechanism side of angle bar 38 is 25-9/16". Lock the nuts on the throw rod against the eye.

8. Position the retarder to position 4 and set the shoe spacing at 3-1/2" by adjusting the nuts on rod 19.

RETARDER MECHANISM

The use of new levers requires changes in the mechanism controller cam arrangement. The parts required for mechanisms 52950-3 and -4 are:

Cam 52138-73 for space 0 Cam 52138-53 for space 3

Cam 52138-74 for space 3 Shaft 52646-10

For older mechanisms, it may be necessary to replace the entire controller, including both cams and contacts.

Referring to Figures 16 and 17, proceed as follows to rearrange and replace the cams:

1. With the retarder in the closed position, remove existing shaft complete 52646-7 from the controller.

2. Remove cotter 3, nut 2, and collar 4 from the shaft.

3. Carefully remove the cams and collars from spaces 0, 1, 2, and 3.

4. Reassemble the cams, as shown in the bottom row, Figure 17, as follows:

   a. For space 3, assemble new cams 52138-74 (ref. 11) and -53 (13) with cam 13 on the bottom. Discard old cam 16.

   b. For space 2, use old cam 52138-57 (10) and new cam 52138-53 (13). Place cam 10 on cam 13 and insert a pin in the left-hand hole.

   c. For space 1, use the cams from old shaft space 2. Replace top cam 15 with cam 52138-56 (9) from old space 3. Place cam 9 on cam 13 and insert the pin in the left-hand hole.

   d. For space 0, replace cam 14 with new cam 5 52138-73 (8).

5. Place the cams, collars, and spacers on the new shaft in the order shown in Figure 16.

6. Replace the collar, nut, and cotter on the shaft.

7. Mill a line across the cam surfaces which will serve as a position guide to facilitate future alignment checks.

8. Insert the shaft complete (52646-10) in the controller.

9. Check the mechanism for proper operation.

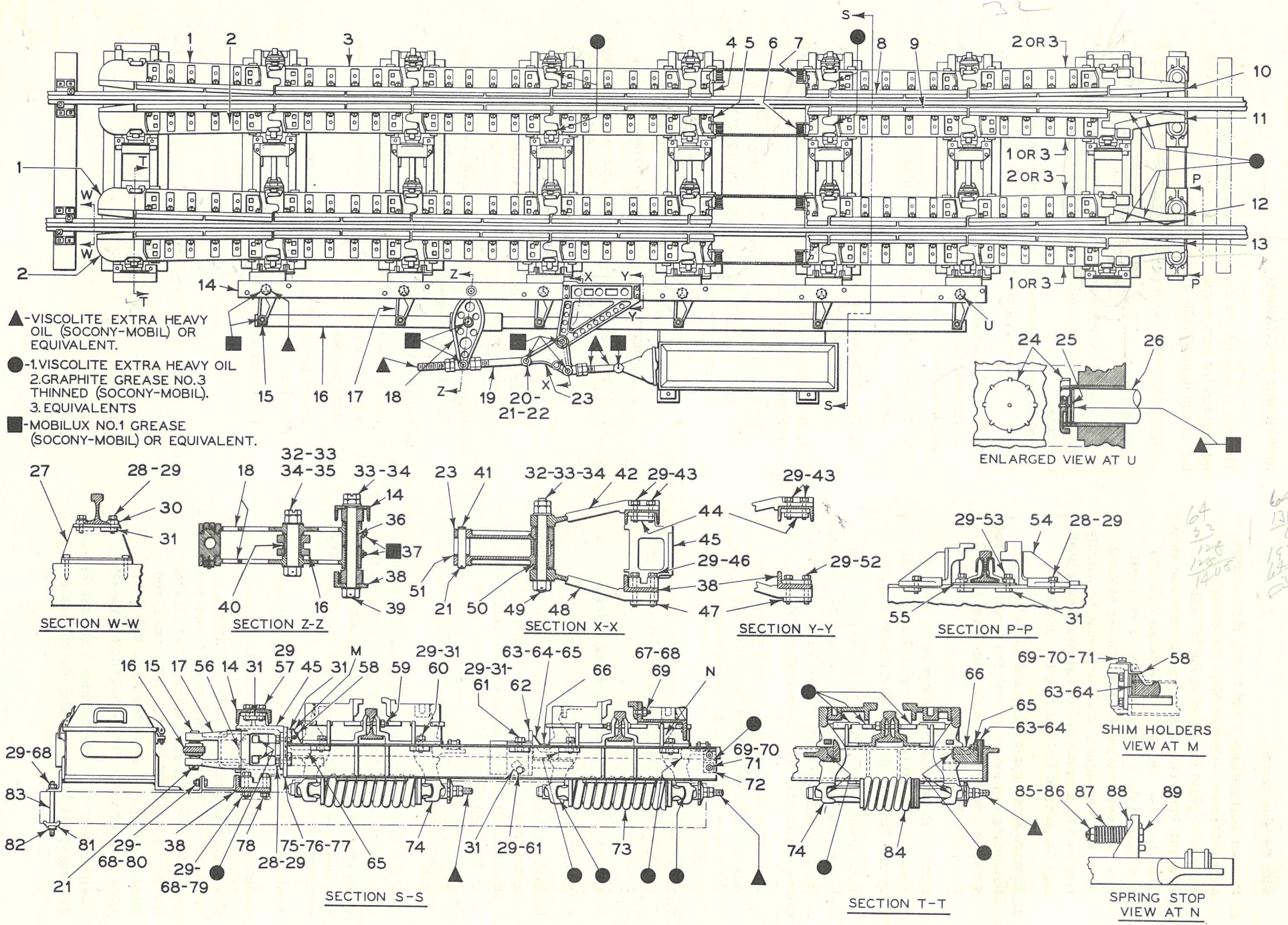


Figure 1. Retarder assembly.

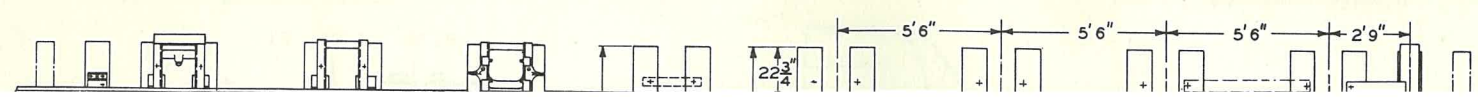


Figure 1. Retarder assembly.

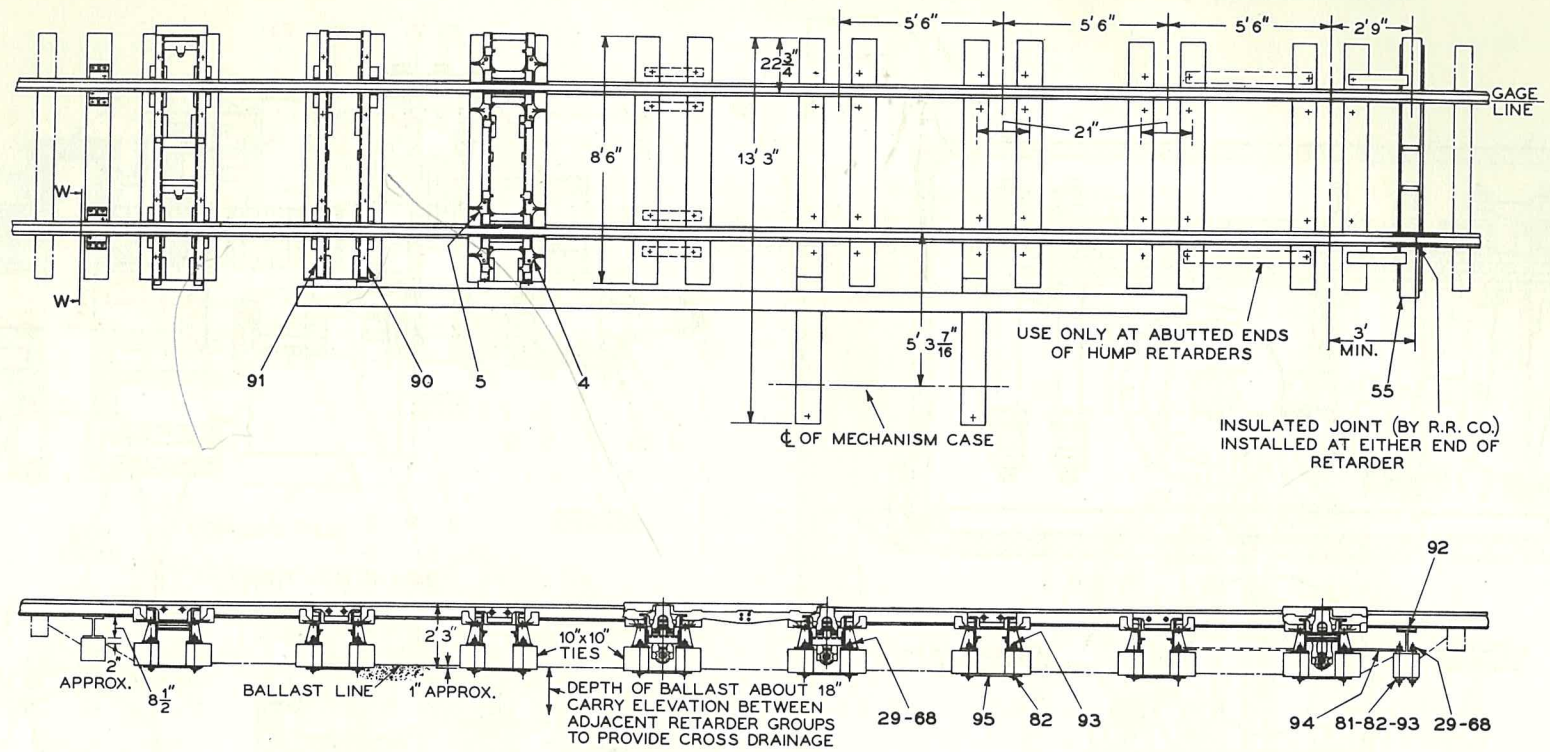
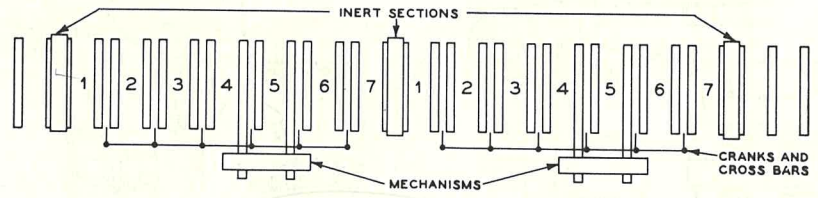
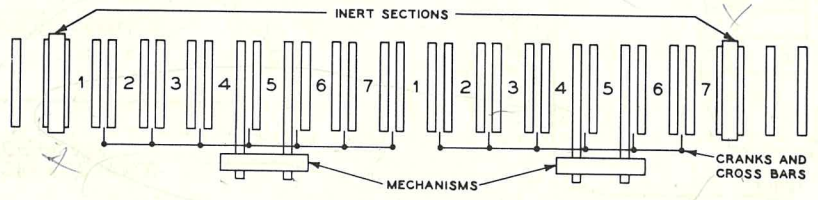


Figure 2. Retarder layout.



Three inert sections.



Two inert sections.

Figure 3. Typical wood tie arrangements.

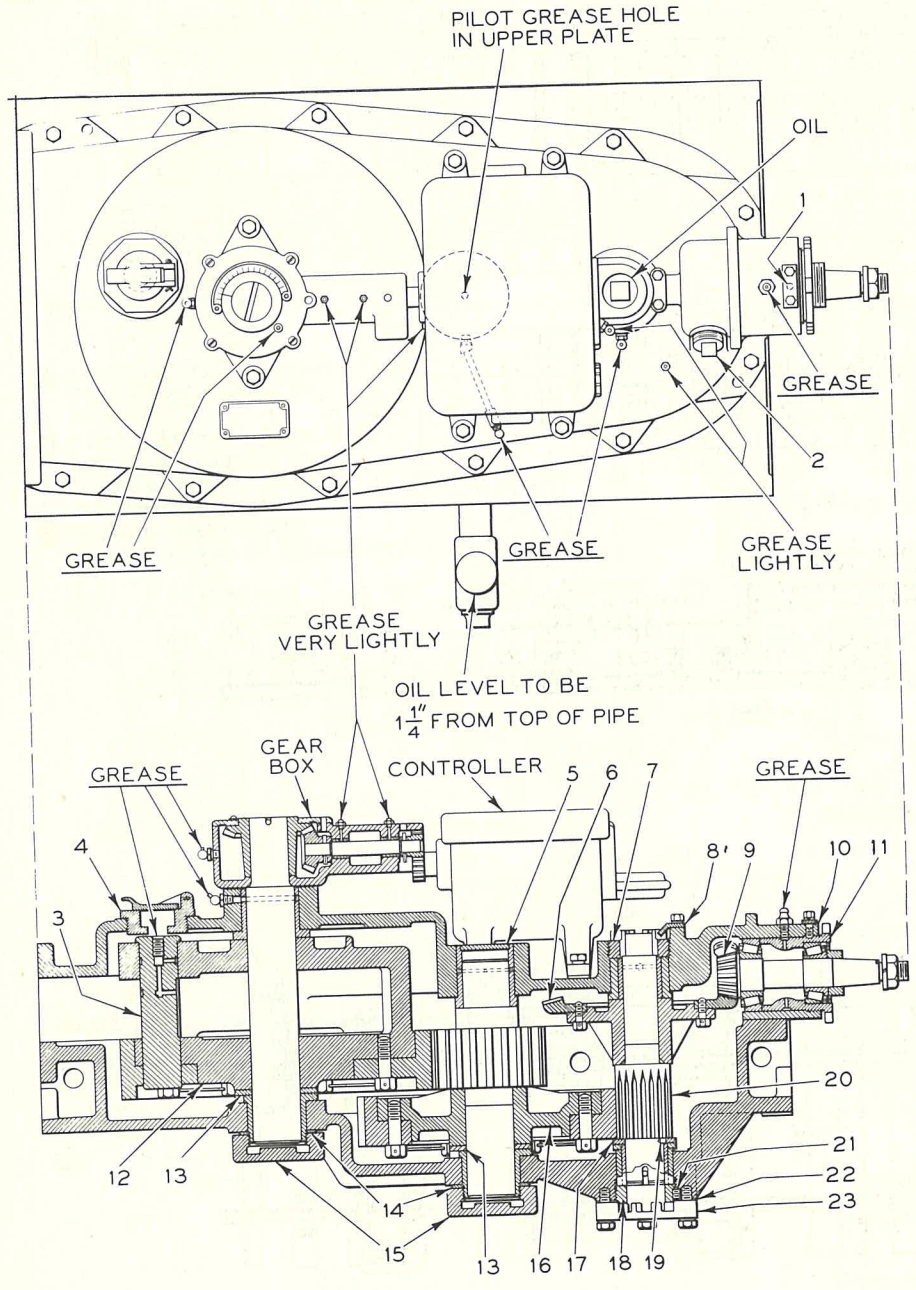


Figure 4. Retarder mechanism.

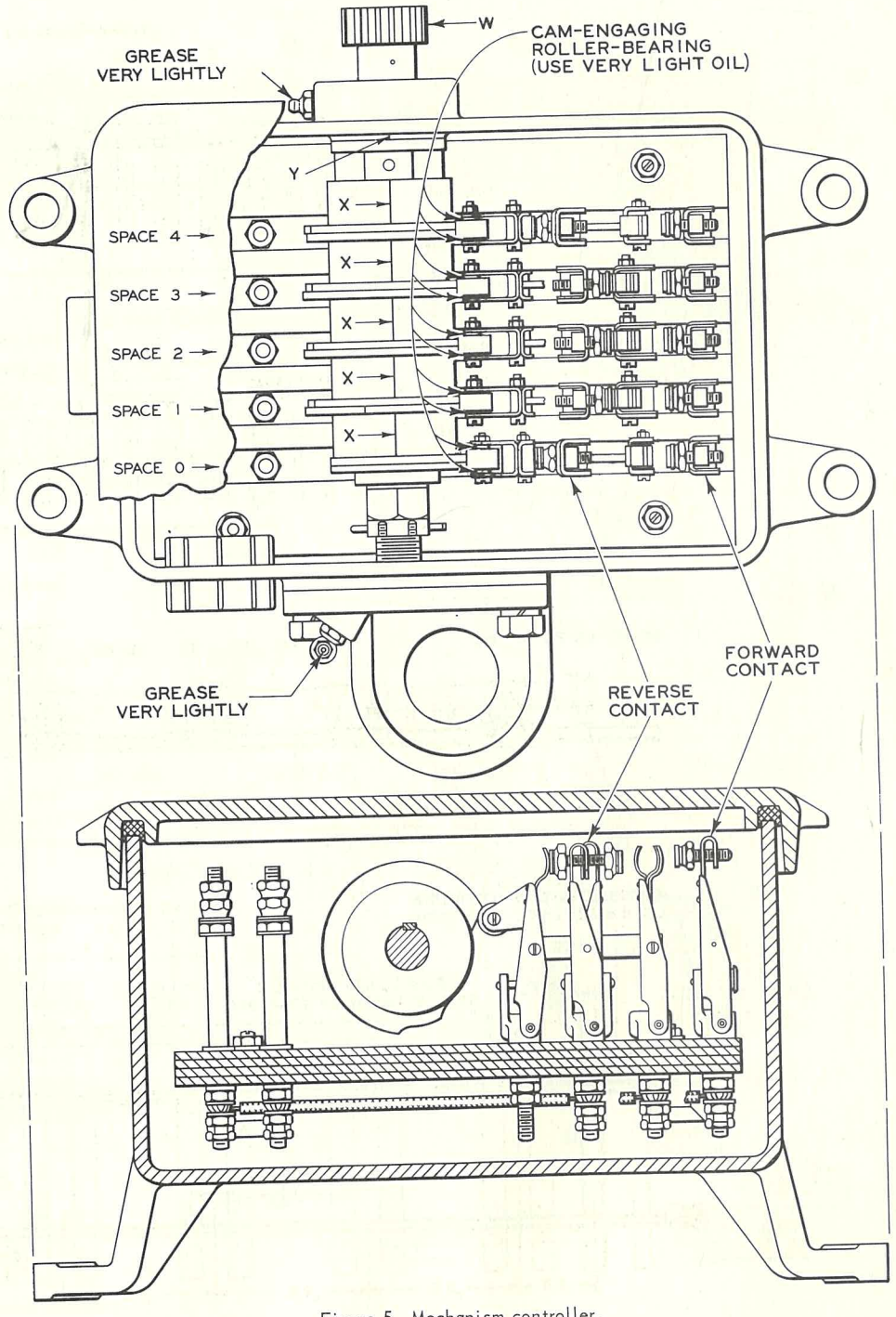


Figure 5. Mechanism controller.

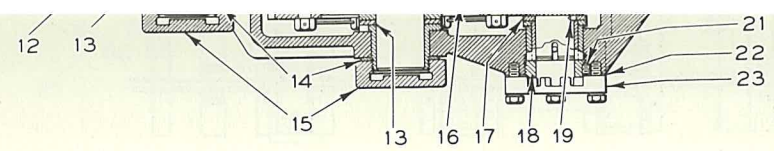


Figure 4. Retarder mechanism.

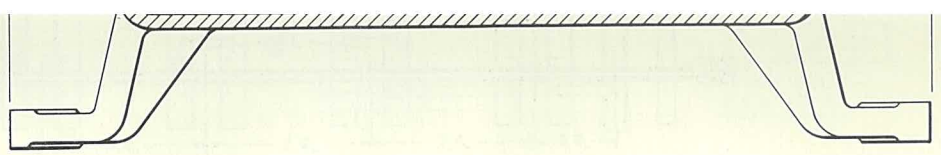


Figure 5. Mechanism controller.

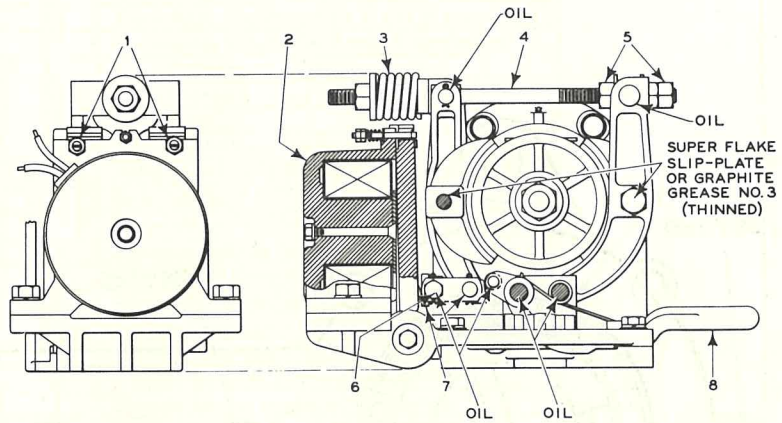


Figure 6. Motor brake assembly.

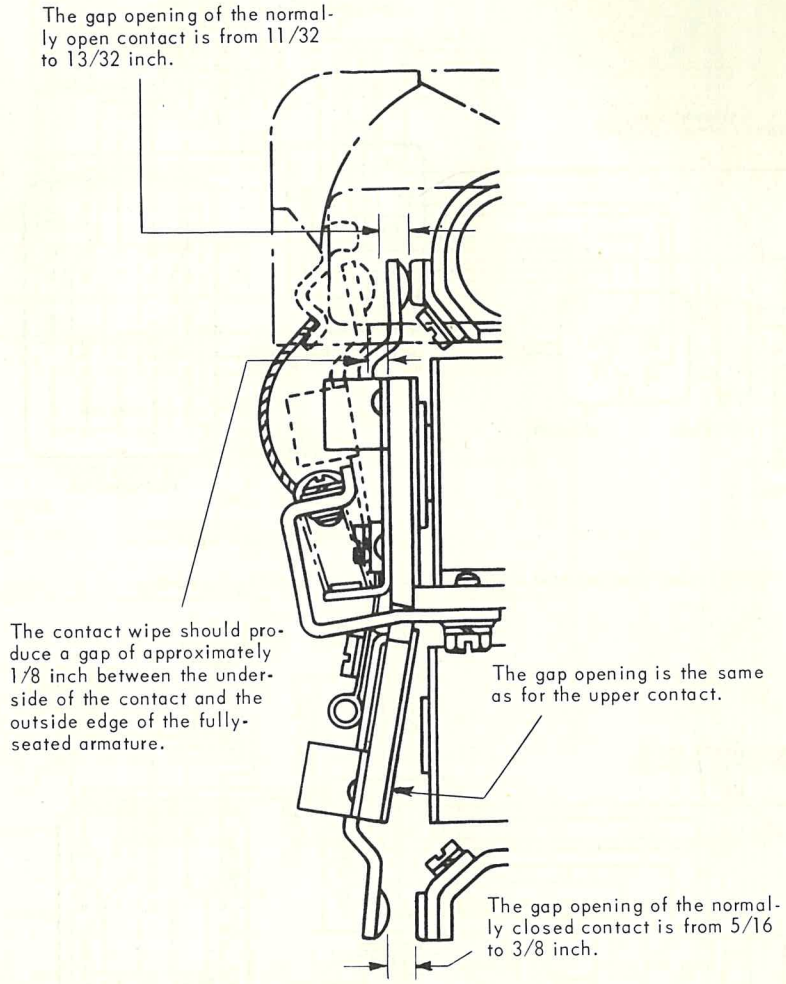

The gap opening of the normally open contact is from 11/32 to 13/32 inch.
The contact wipe should produce a gap of approximately 1/8 inch between the underside of the contact and the outside edge of the fully-seated armature.
The gap opening is the same as for the upper contact.
The gap opening of the normally closed contact is from 5/16 to 3/8 inch.

Figure 7. Contactor adjustment.

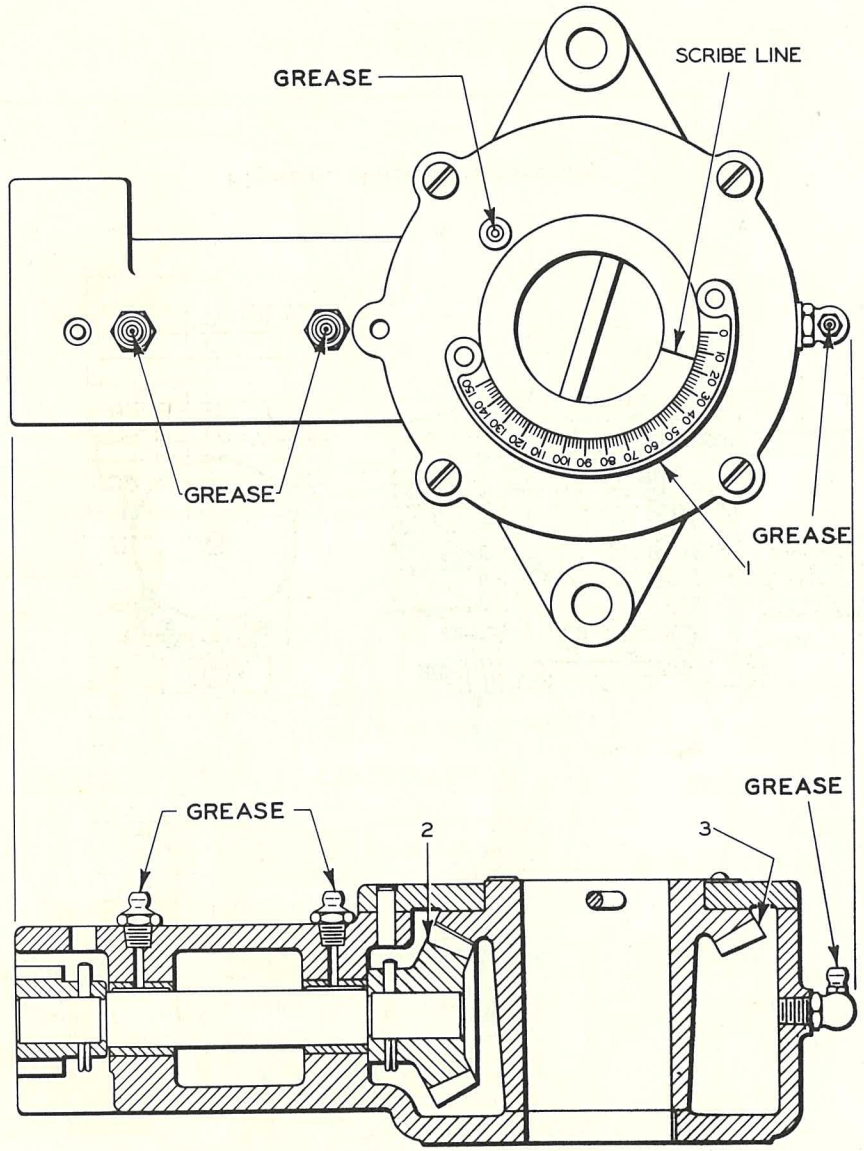


Figure 8. Mechanism gear box.

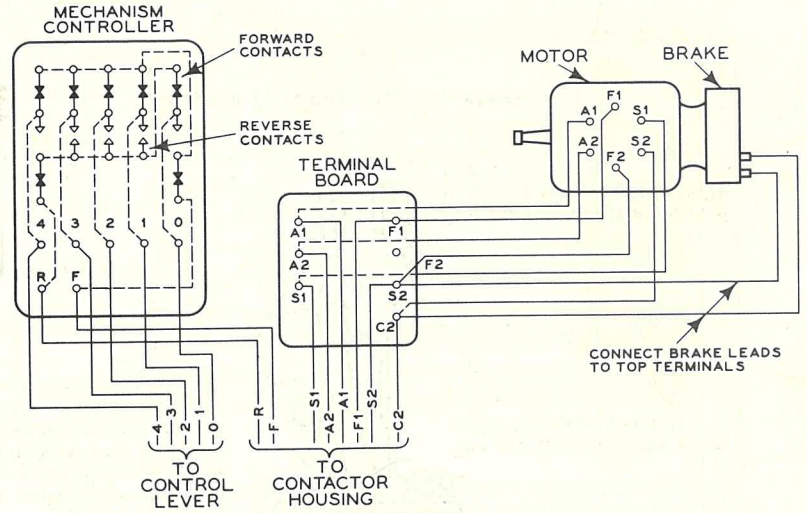


Figure 9. Typical connection diagram for retarder with series brake.

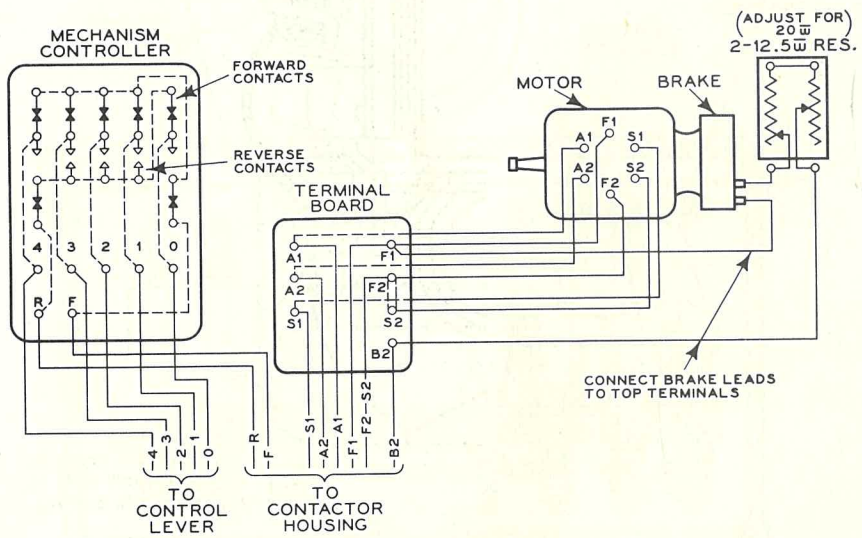
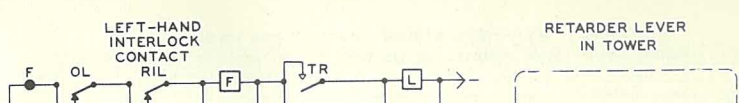


Figure 10. Typical connection diagram for retarder with shunt brake.



NOMENCLATURE FOR WIRING DIAGRAMS

(Figures 11, 12, and 13)

F	Forward contactor and control
R	Reverse contactor and control
FH	Forward contactor back holding coil
RH	Reverse contactor back holding coil
FIL	Forward interlock contact
RIL	Reverse interlock contact
R1	Time-delay resistance for F and R contactors
R2	Holding resistance for F and R contactors
L	Line contactor
SR	Fast-release rectifier for L contactor
TR	Timetactor
R3	Adjusting resistance for TR
A1, A2	Motor armature leads
S1, S2	Motor series-field leads
F1, F2	Motor shunt-field leads
BR	Dynamic braking rectifier
FOL	Forward overload relay
ROL	Reverse overload relay
FP	Forward emergency contact
RP	Reverse emergency contact
0	Control for open position of retarder
1	Control for 1st degree of retardation
2	Control for 2nd degree of retardation
3	Control for 3rd degree of retardation
4	Control for 4th degree of retardation

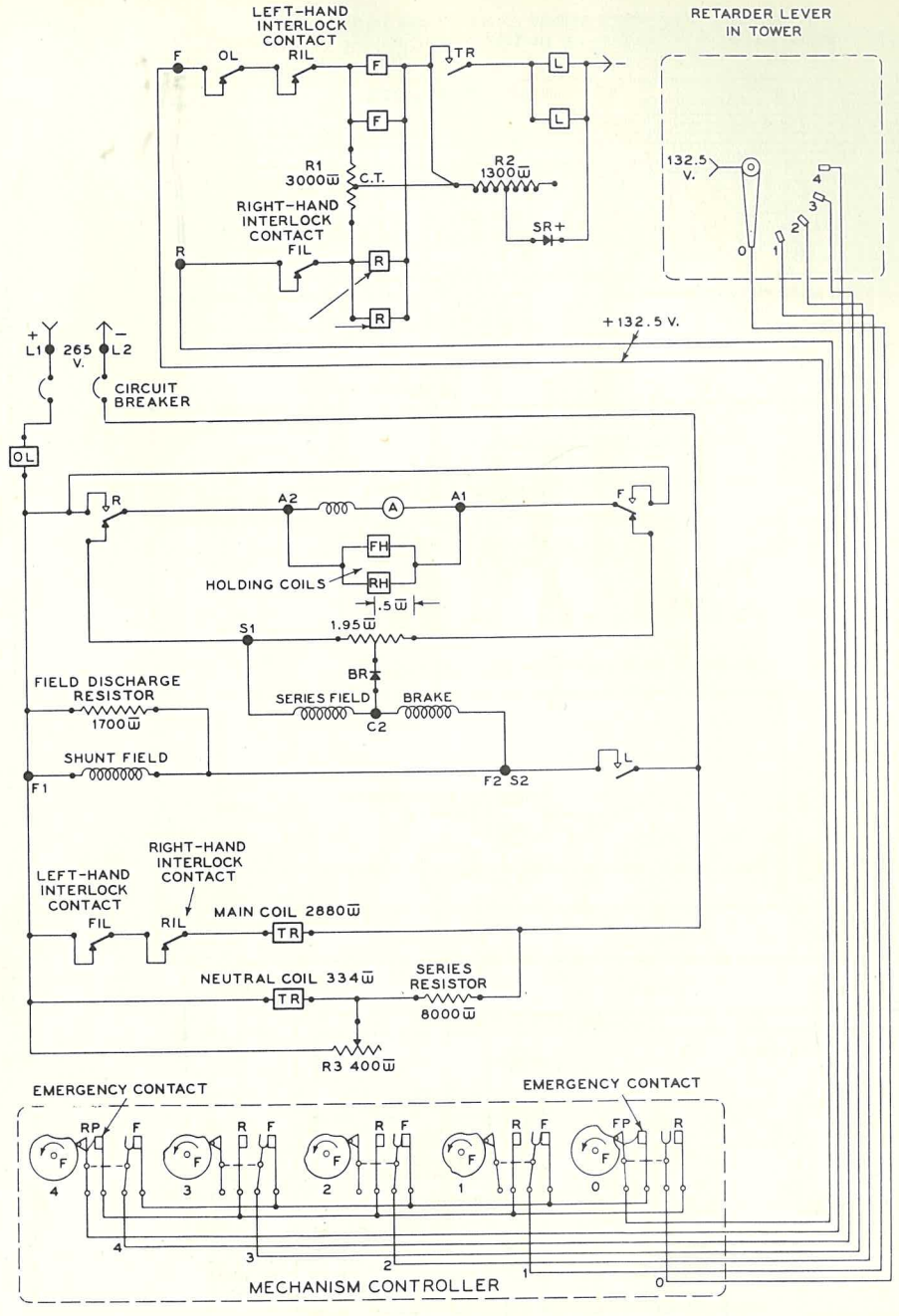


Figure 11. Typical wiring diagram for retarder with series brake motor and contactor panel 52804-7.

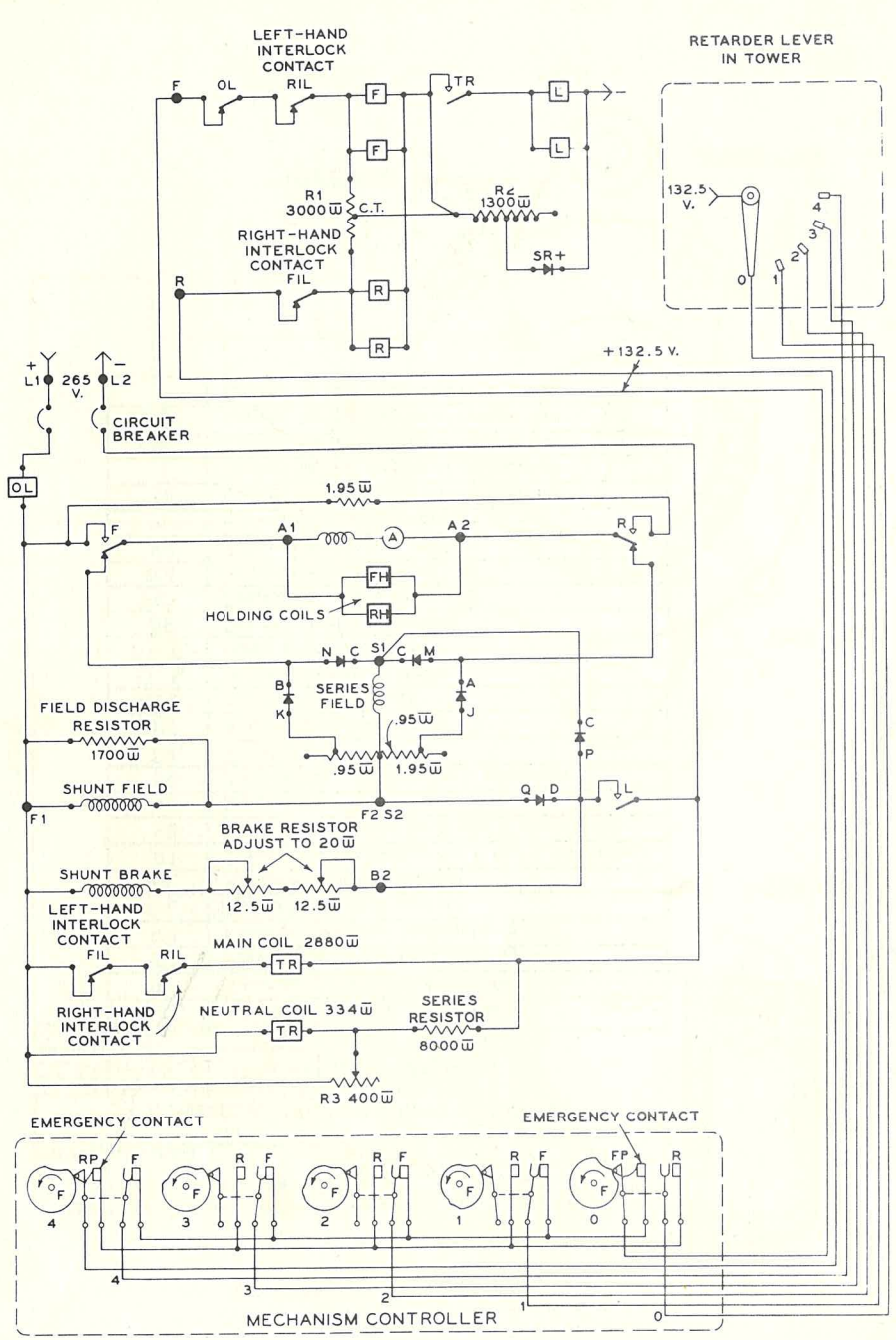


Figure 12. Typical wiring diagram for retarder with shunt brake motor and contactor panel 52804-8.

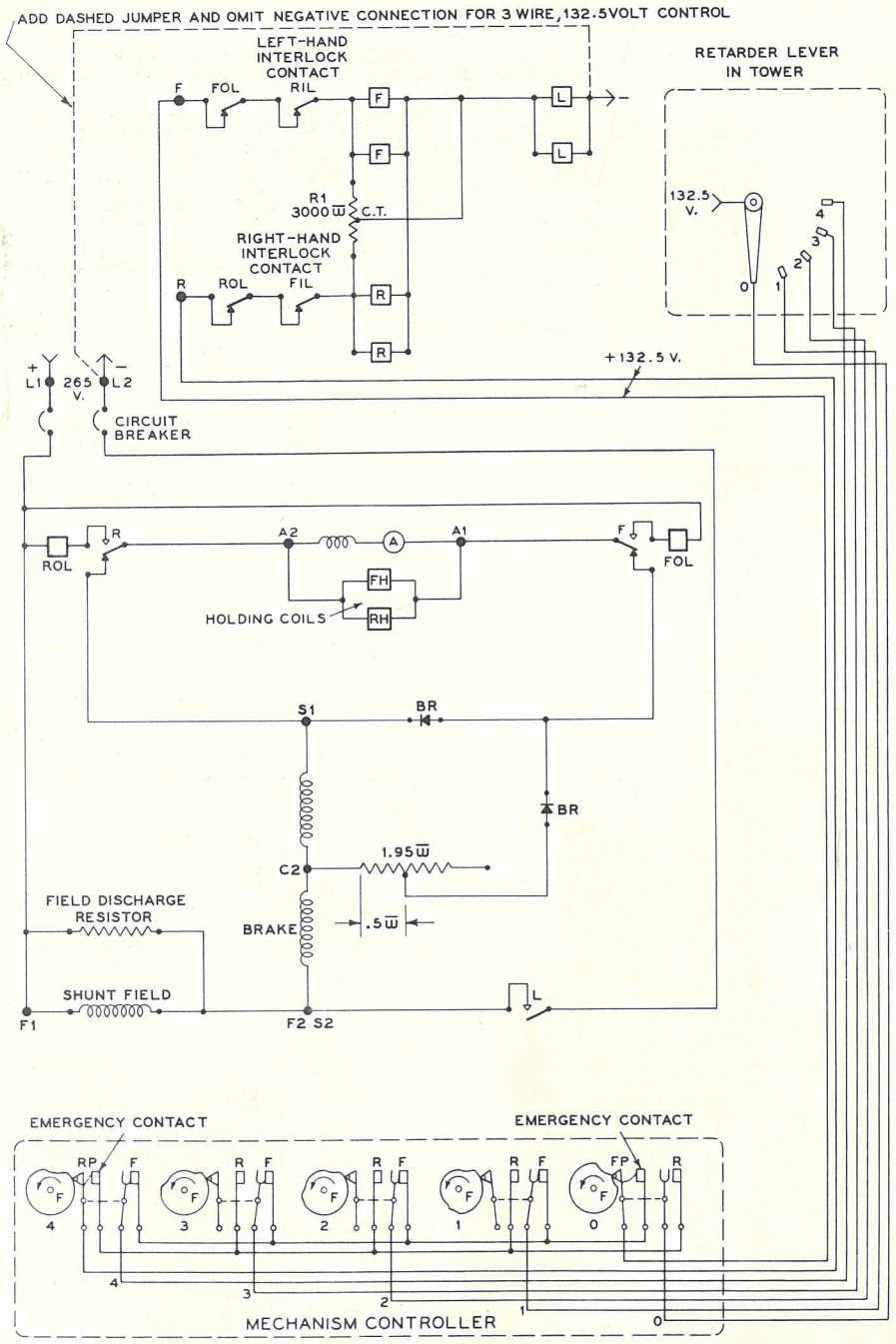


Figure 13. Typical wiring diagram for retarder with series brake motor and contactor panels 52804-9 Gr. 1 and Gr. 2.

NOMENCLATURE FOR OLD CAM SHAFT 52646-7			
REF.	QTY.	DRAWING NUMBER	NAME
1	1	52658-2	SHAFT
2	1	35315-5	NUT
3	1	0169	COTTER PIN
4	1	420-9	COLLAR

NOMENCLATURE FOR NEW CAM SHAFT 52646-10			
REF.	QTY.	DRAWING NUMBER	NAME
1	1	52658-2	SHAFT
2	1	35315-5	NUT
3	1	0169	COTTER PIN
4	1	420-9	COLLAR

Figure 12. Typical wiring diagram for retarder with shunt brake motor and contactor panel 52804-8.

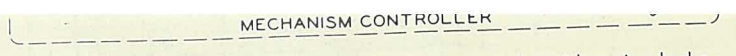


Figure 13. Typical wiring diagram for retarder with series brake motor and contactor panels 52804-9 Gr. 1 and Gr. 2.

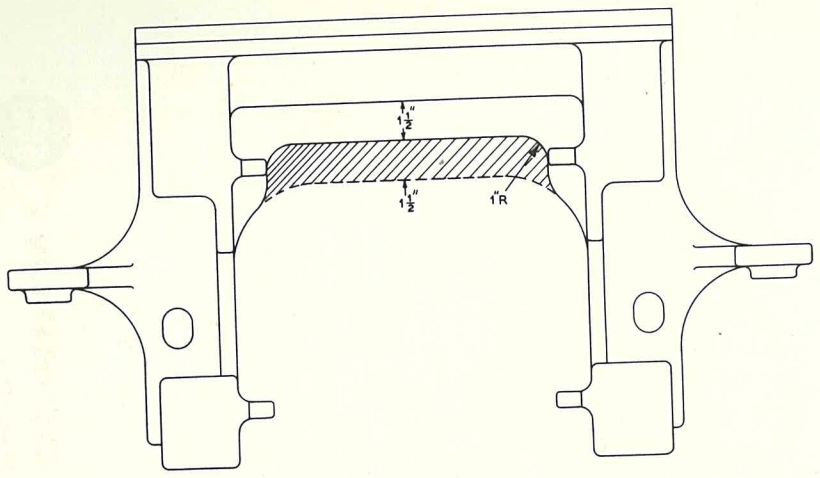


Figure 14. Chair modification.

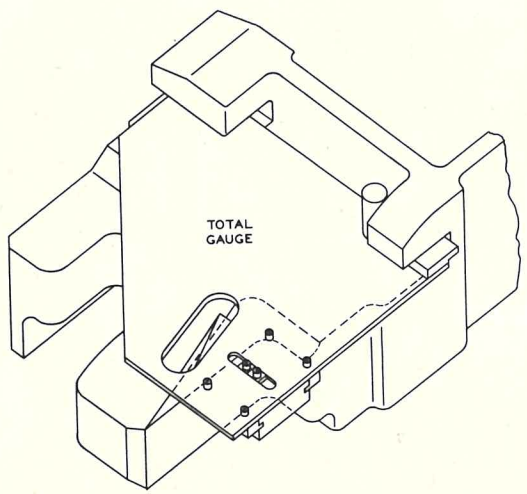


Figure 15. Shoe beam modification.

NOMENCLATURE FOR OLD CAM SHAFT 52646-7			
REF.	QTY.	DRAWING NUMBER	NAME
1	1	52658-2	SHAFT
2	1	35315-5	NUT
3	1	0169	COTTER PIN
4	1	420-9	COLLAR
5	4	626-161	SPACER
6	5	3947	PIN
7	5	7609-5	COLLAR
			CAM POS.
8	—	———	———
9	1	52138-56	SPACE 3
10	1	52138-57	SPACE 1
11	—	———	———
12	1	52138-70	SPACE 4
13	2	52138-53	SPACES 1, 2
14	1	52138-71	SPACE 0
15	1	52138-58	SPACE 2
16	1	52138-54	SPACE 3

NOMENCLATURE FOR NEW CAM SHAFT 52646-10			
REF.	QTY.	DRAWING NUMBER	NAME
1	1	52658-2	SHAFT
2	1	35315-5	NUT
3	1	0169	COTTER PIN
4	1	420-9	COLLAR
5	4	626-161	SPACER
6	5	3947	PIN
7	5	7609-5	COLLAR
			CAM POS.
8	1	52138-73	SPACE 0
9	1	52138-56	SPACE 1
10	1	52138-57	SPACE 2
11	1	52138-74	SPACE 3
12	1	52138-70	SPACE 4
13	3	52138-53	SPACES 1, 2, 3

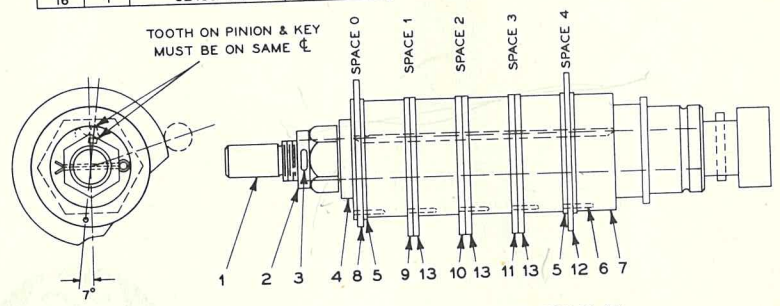


Figure 16. Controller cam shaft 52646-10.

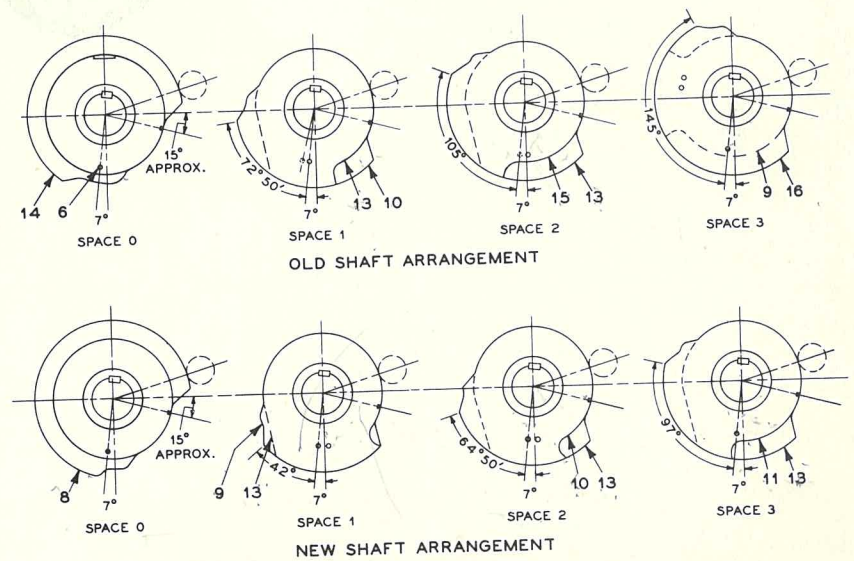


Figure 17. Controller cam positions.

GENERAL RAILWAY SIGNAL COMPANY
A UNIT OF GENERAL SIGNAL CORPORATION
ROCHESTER NEW YORK 14602
ATLANTA GA 30303 CHICAGO IL 60601 MONTREAL 2 PQ NEW YORK NY 10017 OAKLAND CA 94612 ST LOUIS MO 63101

E160 CONTROLS 160-TON CARS

. . . without increased retarder length

With the advent of the new, heavier cars, greater braking force is needed in classification yards. To meet this need, GRS offers the Type E160 car retarder. The Type E160 controls cars of 160 tons with high precision, yet does not "squeeze out" light cars. Also, because of its high retarding efficiency, the Type E160 fits compactly into available retarder space . . . no need for costly relocations of track and switches.

The increase in efficiency has been secured by using longer levers and by modification of the controller cam arrangement. A new weight detector — with four weight classifications instead of the former three — is required in automatic systems. The new longer and heavier levers reduce lever deflection and provide more leverage to increase the force applied to the shoe beams. Closer shoe spacing (3-1/2 instead of 3-3/4 inches) in the maximum retardation position further increases the pressure applied to the car wheels. Retarder control lever positions are the same as before, handling cars of normal weight. A pushbutton on the retarder control console provides manual control for heavy cars.

SOLVING THE HEAVYWEIGHT PROBLEM IN EXISTING YARDS

By far the most practical way to increase retardation for handling heavy cars is to convert your present retarders into E160's.

However, if space is available, you can lengthen your existing retarders to obtain the necessary retardation. The amount of length increase required depends upon the type of retarder. For example, the Type E1H (high outer shoes) retarder would require an increase of 67% in length. The Type E1HS (high outer shoes, special alloy inner shoes) would require a 57% increase.

Another factor affecting the increased length is the number of working shoe beams in the retarder. The velocity head ratings of the E160 retarder, shown on the opposite page, are based on the number of working, or effective, shoe beams.

CONVERTING EXISTING RETARDERS

Conversion of existing Type E retarders to handle up to 160-ton cars requires the following (complete details and procedures are given in GRS Pamphlet 1309):

Levers

Replace existing levers with the new levers, designed longer and heavier for greater strength. With the new levers installed, it is necessary to modify the chairs. This can be done without removing them from the retarder. Also, a minor grinding operation may be needed on the existing shoe beams, depending on the type in service.

Controller

Rebuild the controller to accommodate the new retarder shoe spacing. Three new cams replace three existing cams. The remaining existing cams are removed and repositioned on the shaft along with the new ones.

Pushbutton

Add a pushbutton on the retarder control console to control the new heaviest pressure (for 160-ton cars) position of the retarder.

Weight Detector

With automatic retarder control, install a new weight detector (which identifies four weight classifications) and a wheel detector, if not already in place. Depending on the type of automatic control system, it will be necessary to make certain changes in weight control circuits to incorporate the added retarder position.

For manually operated retarders, it is highly recommended that the new weight detector be used. It identifies weights in each of four classes and thus provides information for more precise selection of retarder positions.

USE GENUINE GRS PARTS

Proper maintenance, and the use of genuine GRS parts when replacement becomes necessary, will contribute greatly toward getting the designed performance and long wear that is built into your GRS retarders. GRS parts embody all the skill and design know-how that result from over 40 years of experience in this field. For example, using genuine GRS shoes ensures rated retardation because the steels are of special patented alloys.

GENERAL RAILWAY SIGNAL COMPANY

A UNIT OF GENERAL SIGNAL CORPORATION

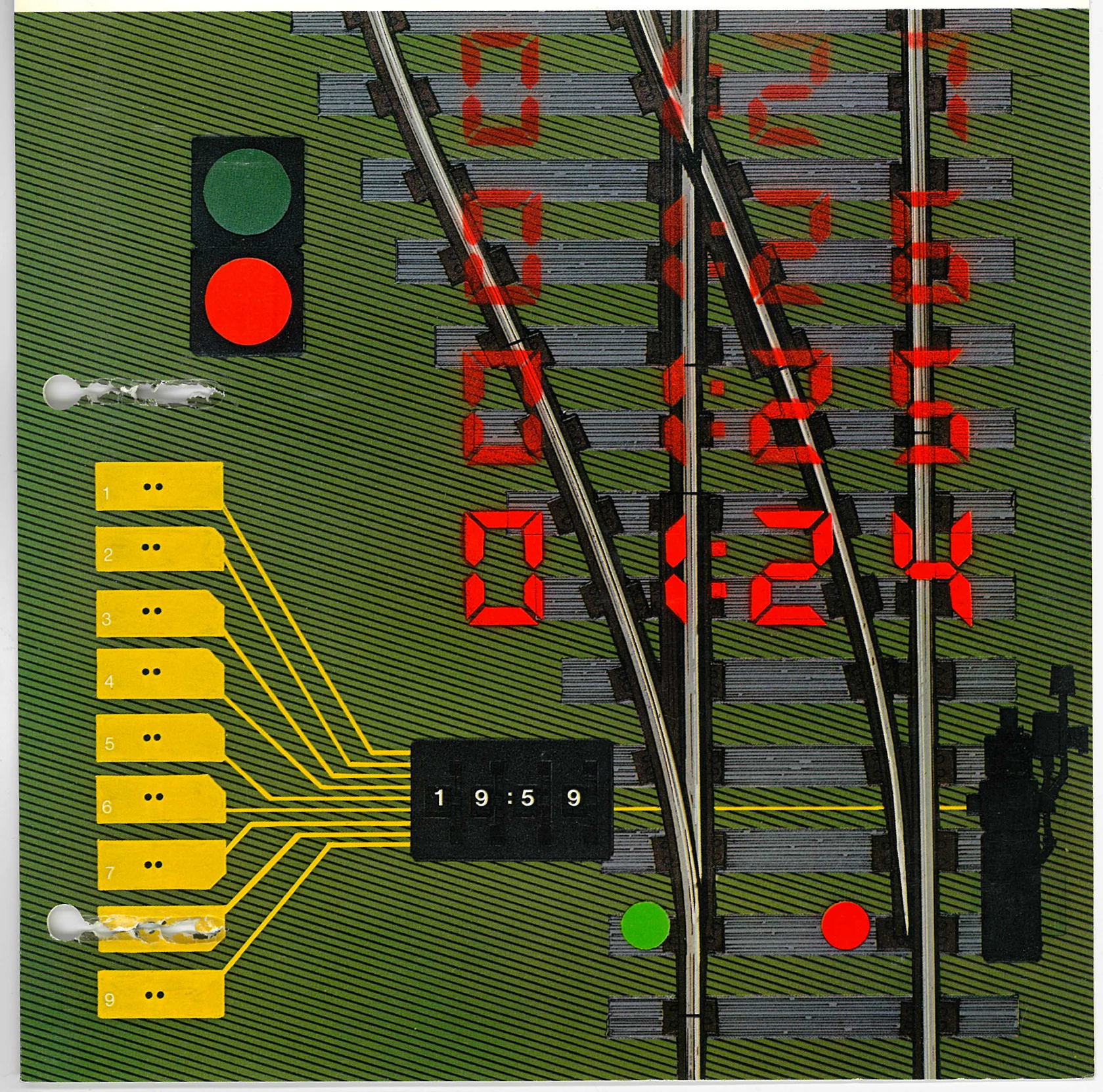
ROCHESTER NEW YORK 14602

ATLANTA BOSTON CHICAGO MONTREAL NEW YORK OAKLAND ST LOUIS ST PAUL

MICROCHRON™ TIMER

MICROPROCESSOR-BASED VITAL FUNCTION TIMER RELAY

GRS



MICROCHRON TIMER

MICROPROCESSOR-BASED VITAL FUNCTION TIMER RELAY

- **Flexibility in setting selection—wide timing range**
- **Reduces inventory of timers**
- **GRS Safety Assurance Logic™ for system safety**
- **Eliminates electromechanical adjustments**
- **Increased accuracy**

With the MICROCHRON timer, GRS incorporated the accuracy and space saving benefits of modern micrprocessor technology into vital safety circuits, and did it with outstanding safety and reliability! The Microchron timer uses solid-state components, including a vitally programmed microprocessor. To perform the timing function, an integral vital relay structure is electronically energized at a set time interval, as directed by the programmed microprocessor.

Rigid safety standards are maintained through the use of **two** different types of logic controls within the timer. The first, called Safety Assurance Logic, continuously verifies the microprocessor functions; the second energizes the relay at the selected time. The extensive use of solid-state components provides almost maintenance-free performance, with the excellent long-term accuracy of a crystal-controlled oscillator.

Expanded Operating Range:

The Microchron timer can be easily and precisely set by a thumbwheel switch at one-second intervals from one second to 19 minutes and 59 seconds. In most cases, users need stock only one model to cover their various applications. The timer can withstand temperatures from –40°C to +70°C.

Typical Applications:

The Microchron timer replaces the GRS Types B2 and KB electromechanical motor timers, and eliminates the electromechanical adjustments associated with these units. Some typical Microchron timer applications include:

Switch lock release.
To delay the release of an electrically locked switch until the expiration of a predetermined time.

Timed release of approach locking.

Highway crossings.
To provide timed approaches.

Mass transit.
To delay clearing of signals for speed control purposes.

Application Parameters:

The Microchron timer provides a vital time delay. Any interruption of power causes immediate reset to the beginning of the selected time delay. For example, momentarily extraneous electrical noise, where the input power drops below the minimum input voltage for a significant period of time (milliseconds), causes the timer to fully reset.

The Microchron design is based on the premise that any component degradation or failure, including the hardware (printed circuit boards, etc.), results in a longer than programmed time delay extending to a "permanently off" situation for typical component failures.

The "instant reset" feature of the Microchron precludes the need for the back-check contacts provided on the Types B2 and KB motor timer relays. The contact configuration of the Microchron timers permit them to easily replace Types B2 or KB motor timers where the circuitry permits. The Microchron timer also provides a number of additional contacts not available on the Types B2 and KB motor timers for greater application flexibility.

Microchron Timer Configurations:

B2 Package (Plug-in Units)

- Plug-in replacement for Type B2 motor timers.
- Increased contact complement: two front-backs (silver carbon-to-silver and silver-to-silver), three fronts (silver carbon-to-silver), and two backs (silver-to-silver) is standard contact configuration.
- Thumbwheel switch adjusts timing in one-second intervals.
- Accuracy: ±0.1% of setting, plus a nominal delay of 250 milliseconds (750 milliseconds maximum).
- A four-digit LED display indicates the time remaining before the contacts are actuated.
- A red LED indicates power is applied to the relay. The intensity of this LED is pulsed during the actual timing period, and then goes to a steady bright red upon completion of the time period.
- A green LED turns on at the end of the timing cycle.

Voltage Range D-c	Time Range	Input Current
8-15	0-20 min	0.35 amp
26.5-31.5	0-20 min	0.17 amp

KB Package (Shelf-mounted)

- Similar in size to the GRS Type KB motor timer, with top-located AAR posts.
- The contacts, thumbwheel switch, LED displays, accuracy, and voltage/time ranges and input currents are the same as for the Type B2 package.

A New Industry Standard:

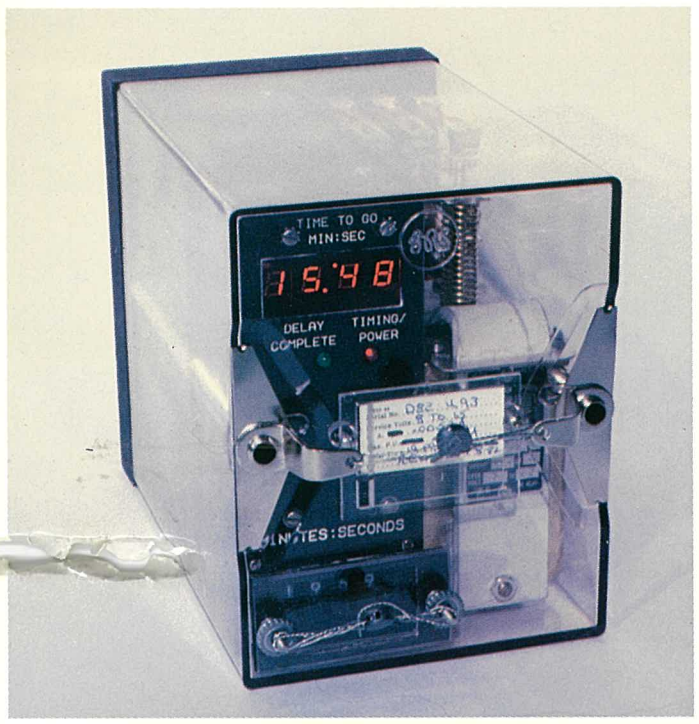
The microprocessor-based solid-state Microchron timer is an industry first, and another example of how GRS continues to implement new technologies safely and reliably into transportation control systems. It's typical of the advanced thinking that has been helping GRS improve railroad signaling technology and set industry standards for almost a century.

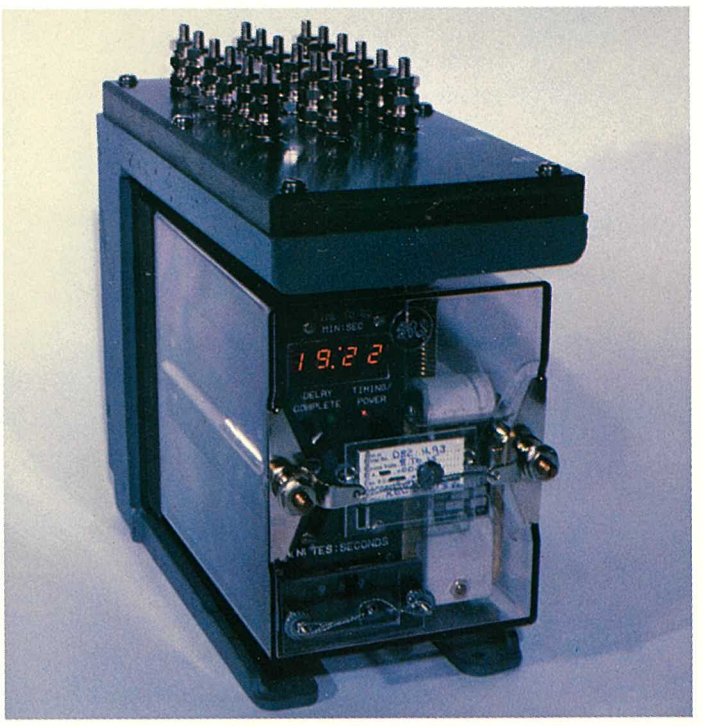
GRS is a ful
equipment t
world. With
engin
every produ

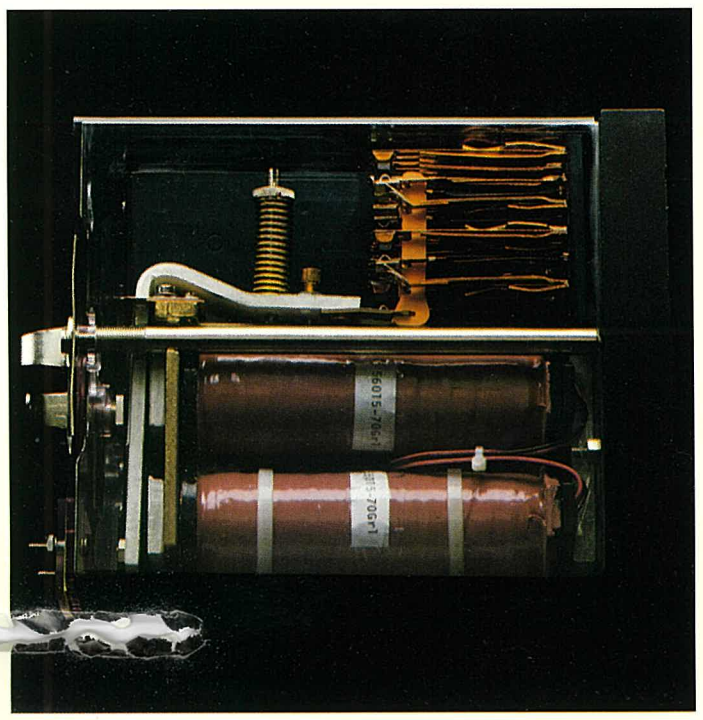
For more int
MICROCHR
systems, or
office.

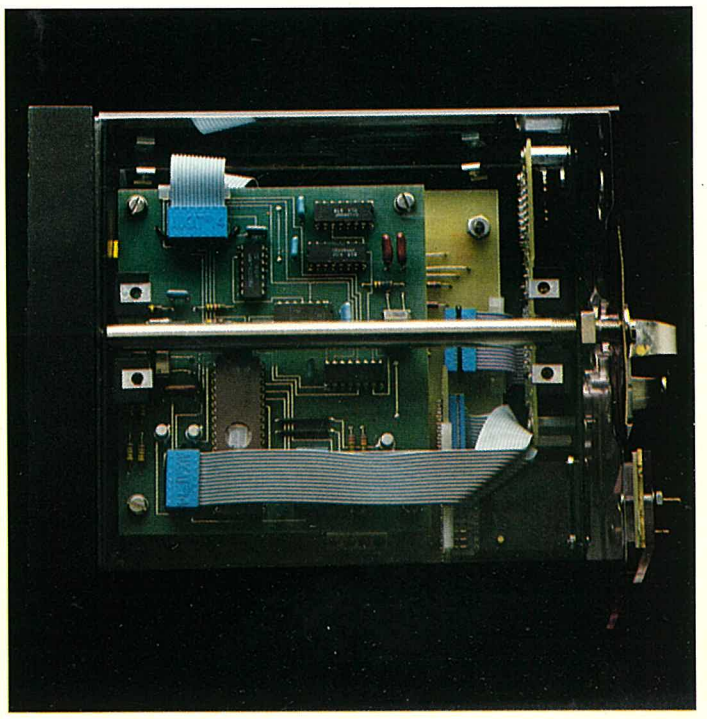
GRS is a full line supplier of signal and control equipment to railroads all over the U.S., Canada, and the world. With a full range of planning, research, engineering, installation, and service capabilities backing every product and every system.

For more information about the microprocessor-based MICROCHRON TIMER, or any other GRS components, systems, or capabilities, contact your nearest GRS sales office.









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